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THE AMERICAN SPECIES OF SCUTELLARIA

BY

CARL EPLING

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THE AMERICAN SPECIES OF SCUTELLARIA

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CARL EPLING

THE GENUS *Scutellaria* is found in most parts of the world. Its principal area of distribution in the Old World is found in the central Eurasian land mass from Syria to the Altai Mountains and the Himalaya, but it occurs also to some extent in central Africa, Malaysia, and Australia. It is notably absent from Polynesia. In the New World, where it is the third largest genus of Labiatae, it ranges from the Arctic Circle to Tierra del Fuego, and is represented by 113 species as defined in this paper. The genus reaches its greatest diversity in the central Mexican plateau, with secondary centers in the southeastern United States and the northern Andes.

Like most genera of the Labiatae, *Scutellaria* is montane or colline, but unlike other large genera is rarely insular. Its absence from the Pacific Islands, which are endemic centers for other generic groups of Labiatae, is possibly significant. The Caribbean islands and those adjacent to the Pacific Coast are areas of endemism for other Labiatae; but *Scutellaria* is represented in the Caribbean by only two species, neither endemic, and on the Channel Islands off California it is represented by a single, mainland species of California. It is not known to occur on Guadalupe, Cedros, Socorro, the Galapagos group, or on Juan Fernandez. A single species has been found on the Falkland Islands, possibly carried thence from the mainland of South America, and is the only insular species of that continent.

CHARACTERS OF NORTH AMERICAN SCUTELLARIA

Scutellaria is unquestionably the most sharply defined of the Labiatae and, with the exception of the closely allied monotypic genus *Salazaria* which occurs in the southwestern United States, is not immediately allied to any other generic complex. It is sharply set off not only by the peculiar gynophore, which is variously developed, and the nature of the nutlets, which are variously sculptured, but by the conformation of the calyx, both at anthesis and at maturity, by the conformation of the corolla, in which the upper and lower lips are joined in a peculiar way, and also by the fact that one anther sac of each of the anterior stamens is regularly suppressed. In vegetative habit it is typically a Labiate genus.

Although sharply defined and separated from any other generic complex by a deep gap, the genus is singularly homogeneous for one of its size and dispersion. Nor is this unexpected, for the pattern of variation within the Labiatae differs with each genus or generic complex. No two groups of any appreciable size are quite the same. Elsewhere (Am. Nat. 72:547–561, 1938) I have touched briefly upon the nature of supraspecific variation within two of the larger genera, *Salvia* and *Hyptis*. Those genera are widespread and the species are often highly localized. Inasmuch as herbarium stores of many of the species are meager, and a field study of the whole group is impossible at present, variation within these genera can be studied only in its broadest outlines. *Scutellaria,* however, offers a more favorable field for study, for many of its species are frequently collected in the United States, and some of the tropical species are fairly well represented in herbaria. The present observations on variation are based largely upon herbarium studies. They can do no more than point to the desirability of similar studies on living populations.

The flowers of *Scutellaria* generally show less variation than those of other Labiate genera, and excepting the closely allied *Salazaria,* which may be considered a *Scutellaria* with inflated calyx, are rather sharply set off from the remainder of the family.

The calyx presents little variation either in size or conformation. At anthesis it usually resembles a compressed pouch, both lips being equal and entire. In most of the genus the upper lip is produced into a small transverse squama which enlarges during maturation of the fruit, forming an erect structure several millimeters tall and strongly compressed transversely to the main axis of the flower. In five species, *S. lateriflora* (*Lateriflorae*), *S. Perilomia* and *S. ocymoides* (*Perilomia*), *S. nummulariaefolia* (*Antarctica*) and *S. volubilis* (*Perilomioideae*), the squama is absent or but slightly developed, and both lips develop more or less equally at maturity, resembling the two halves of a walnut shell. These five species do not appear to be immediately allied when other attributes are considered; on the contrary, they belong to rather diverse sections, save only *S. Perilomia* and *S. ocymoides.* In all species the upper lip falls away at maturity, thus releasing the nutlets.

The corollas vary, but little, in six ways: first, in the position of the pairs of stamens with reference to the tube; second, in the curve of the tube; third, in color; fourth, in size (usually determined by the length of the corolla tube); fifth, in the distribution of hairs within the tube, the throat, or the galea, or upon the lip; sixth, the conformation of the corolla limb (notably in *Perilomia* and *Perilomioideae*). The shape of the corolla is usually correlated with corolla color and with vegetative characteristics of the plant, a correlation which usually serves to define groups of species.

The genitalia are nearly uniform. The upper style branch is uniformly short (or at times apparently wanting) and is appressed to the lower. The position of the anthers within the galea is uniform. The anther sacs are variably ciliate; the filaments usually are finely hairy. Both stamens and style are always included in the galea. Only the position of the stamen pairs upon the corolla tube is variable.

The nutlets are perhaps more variable in pattern than any other flower part. The gynobase upon which they are elevated is variously developed. The nutlets themselves, while mostly of the same size, may be either black, brown, or buff; they may be variously papillate or tuberculate, or covered with pegs or squamellae. In some species the papillae or squamellae coalesce around the equator, forming a smooth or a lacerate (in *Perilomia*) protruding band. In herbarium material comparative study of the nutlets is difficult because mature nutlets are often dislodged and lost in pressing. Apparently no single pattern is referable to any one species group.

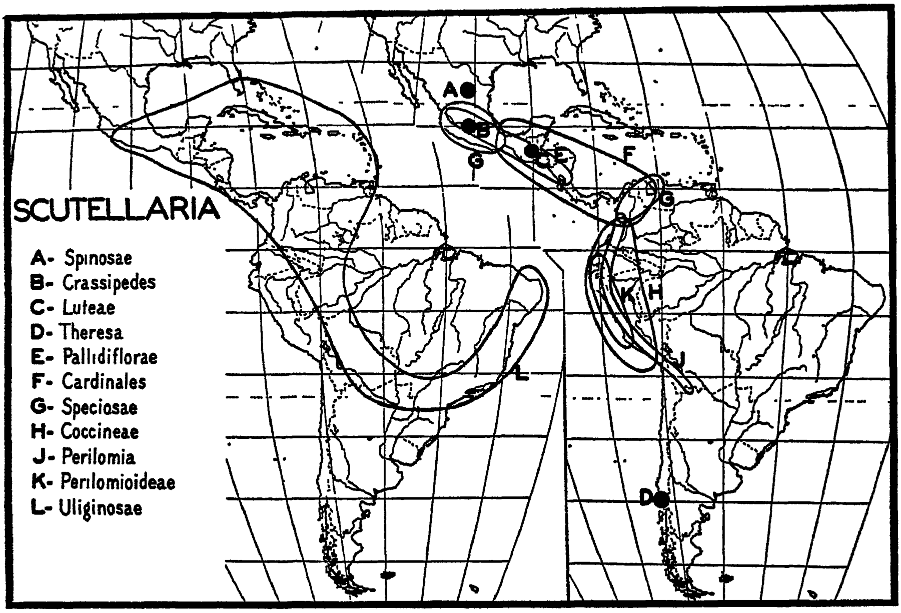
In growth form *Scutellaria* is herbaceous and of intermediate size, but variable in the nature of the underground parts. A few tropical species are shrubs or half-shrubs, but apparently not very woody. In this respect they are probably similar to such types as *Fuchsia*. Three species are annual. Most of the temperate species die back each year. The underground perennial parts are usually in the form of rhizomes, usually slender, and sometimes filiform. These may bear branches which appear during and after the flowering season and ultimately terminate in tubers. Or the rhizome may be in effect a small caudex, sometimes woody, from which several flowering stems arise. In some tropical sections with short rhizomes the roots are fascicled, and seemingly more or less fleshy, and fusiform.

The arrangement of flowers is of two principal sorts. In most temperate species the flowers are borne opposite in the axils of the upper bracts, the members of each pair flowering simultaneously, the pairs flowering consecutively. In most tropical species, the flowers are borne in bracteate racemes, but, contrary to the usage of the family, are irregularly disposed, not opposite. The bracts may then be deciduous, at least in age. The leaves vary from linear to rotund, and different leaf types are scattered throughout the genus. The pubescence is varied.

The range of variation in all parts accordingly is much less than that in other genera of Labiatae of comparable size, and sectional segregation is based largely upon vegetative characteristics and growth form, and to a less extent upon minutiae of floral structure and color. If such considerations form the basis for sectional differentiation in *Scutellaria,* it becomes apparent that the morphological basis for specific and subspecific differentiation is less than in most Labiate genera and that the species are correspondingly "small."

If flower and fruit characters alone are to be considered as fundamental to specific segregation, as they sometimes are, then I suspect that the total number of species would be reduced. Such a section as *Annulatae* would probably consist of two, rather than of fifteen "species," for about the only "fundamental" and definitive characters are the nutlet patterns. For practical classification such a view is perhaps tenable. I question whether it is desirable, for it is an error to believe that the morphological indicators of speciation are confined to any part of the plant. Instead, it would seem, in the absence of positive data on isolating factors, that the sum of the morphology of a group should be interpreted as indicating how effective those factors are. In *Scutellaria* such indicators seem to be largely vegetative. The pattern of variation is so complex, however, that until more is learned of the nature and relationships of the variants, it has seemed preferable to recognize as species, solely on morphological grounds, a number of entities which other botanists might prefer to designate as subspecies. The taxonomy of the paper should therefore be recognized as exploratory and suggestive, and by no means definitive. I shall be amply rewarded if it serves as a basis for a more comprehensive and intensive attack.

Some evidence suggests that while most species groups appear to have been derived in large part by fragmentation of previously existing species through cumulative mutation and selection, some, or parts of some, appear to have been complicated by hybridization between groups of their prototypes. The greatest uniformity within sections is seen in South America and the tropics of North America. The morphology of these tropical groups suggests that each originated through cumulative mutation and isolation, rather than through hybridization. The greatest diversity is seen in temperate North America. Such diversity in the north temperate regions may possibly be ascribed to the more frequent production of allopolyploids there, resulting from dislocations of the flora during glaciation.



Map 1. Approximate distribution and geographic relationship of tropical sections of *Scutellaria* in the New World.

I have nowhere observed any evidence which would suggest that these subgeneric (or supraspecific) groups are distinguished by anything other than a "change of emphasis" (E. Anderson, Am. Nat. 71: 223–235, 1937; Epling, Am. Nat. 72: 547–561, 1938) in a previously existing pattern, unless indeed, the growth forms might suggest a "change of pattern."

ACKNOWLEDGMENTS

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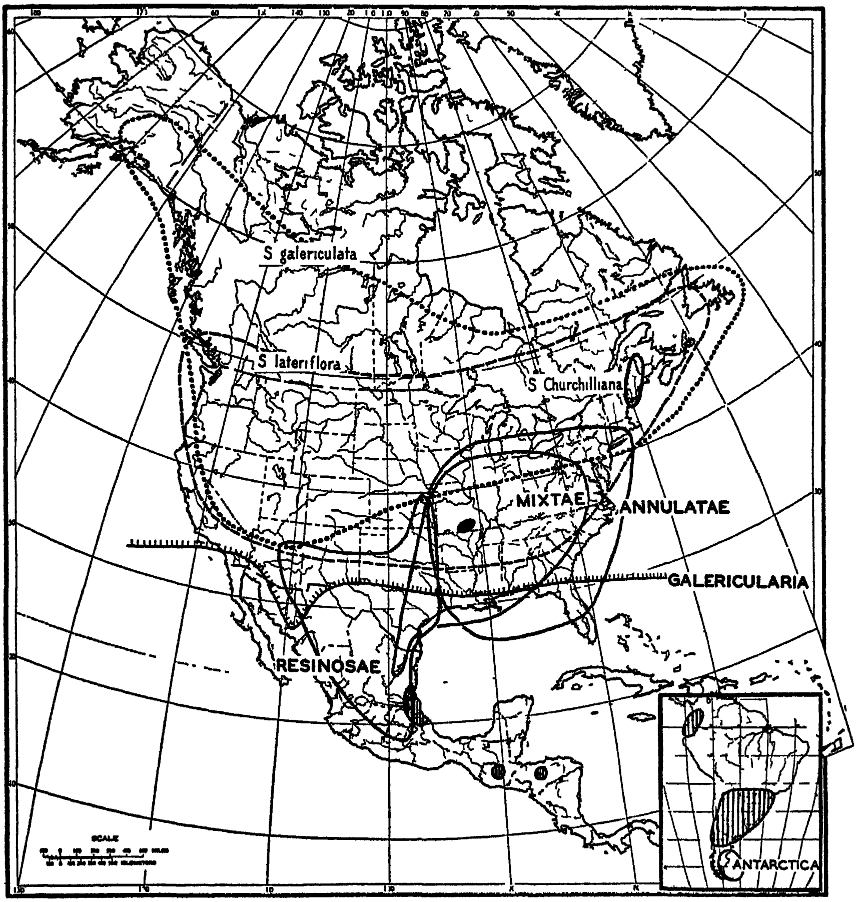
Garden, the National Herbarium at Stockholm, the Herbarium of Stanford University, the Rocky Mountain Herbarium, the Herbarium of the University of Texas, the Herbarium of the University of Michigan, the National Herbarium at Copenhagen, the Delessert and Boissier Herbaria at Geneva, the Herbarium of the University of Tennessee, the California Academy of Science, the Herbarium of Pomona College, the Herbarium of the University of Washington, the Herbaria of the University of Oregon and the Oregon State College, and the Herbarium of the University of Pennsylvania.



Map 2. Approximate distribution and geographic relationship of temperate sections of *Scutellaria* in the New World. Section *Saxicolae* is shown as a black oval. Tropical species of *Galericularia* are indicated by vertical hatchments.

The author is under great and lasting obligation to the officials of these herbaria, the invaluable collections of which have so generously been made available. He is no less indebted to the continued and generous support of the Board of Research of the University of California. Much assistance has been afforded by the United States Work Projects Administration (Project

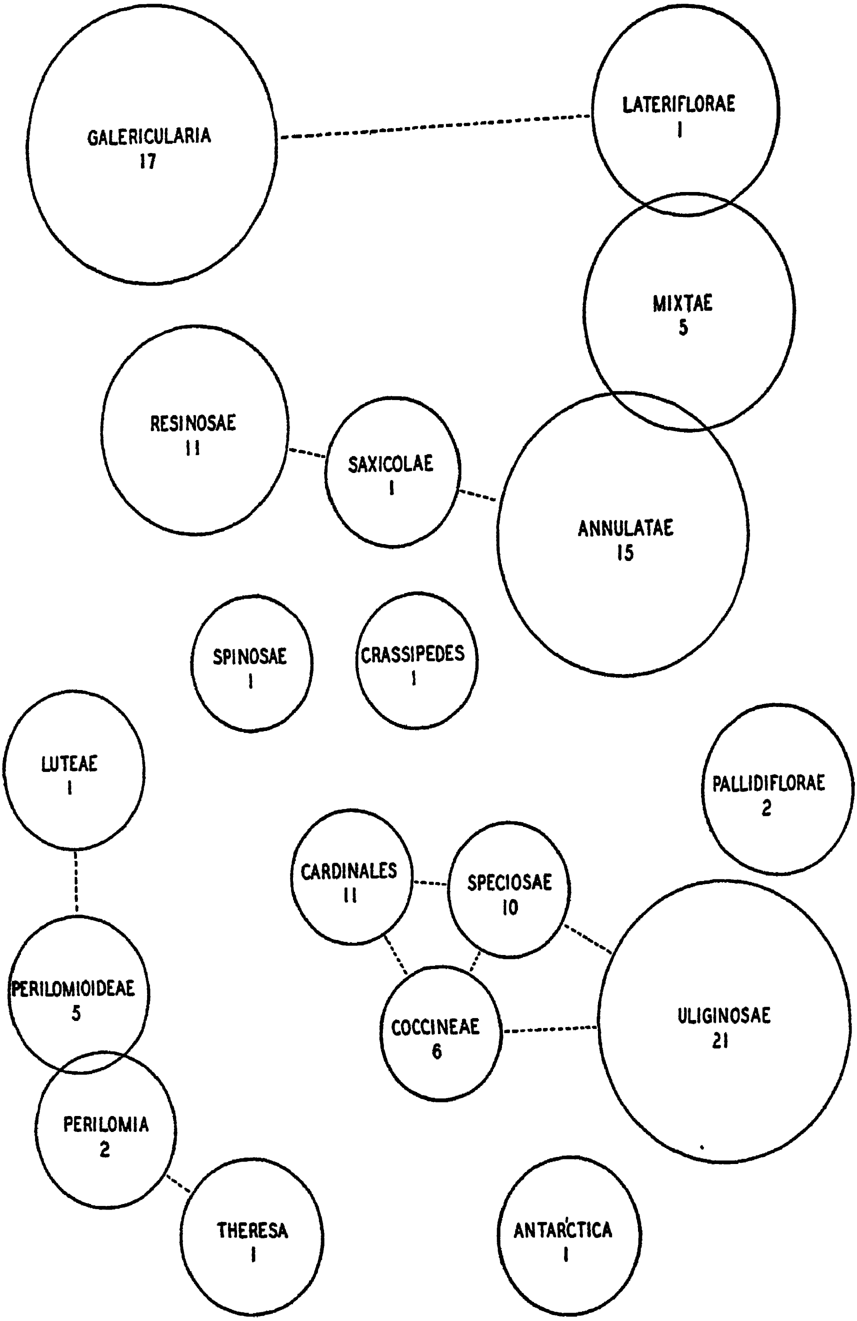


Fig. 1. Possible relationships of the New World sections of *Scutellaria*. Numerals indicate the number of species within each section. Overlaps indicate a closer relationship than the broken lines, which, in the temperate sections, possibly indicate a connection through hybridization. *Uliginosae* is possibly so connected with *Galericularia*.

11775–2) for clerical and illustrative work. Finally, it is a pleasure to recall the continued interest and assistance of many colleagues, both in this country, and in Latin America.

GENUS **Scutellaria**

Scutellaria L., Sp. Pl. 598, 1753. The lectotype is *S. galericulata.*

Small-leaved herbs or half-shrubs of varied growth form and habit; flowers solitary in the axils of more or less diminished leaves or bracts and opposite, or irregularly disposed in the axils of bracts, or irregularly verticillate, the bracts being either persistent or deciduous; flowering calyces pouch-shaped, two-lipped, the lips equal in length and both entire and rounded, the upper lip usually bearing a transverse squama which develops into a transverse erect "scutellum" compressed contrary to the major axis of the flower, rarely subequal at maturity, and both lips more or less concave or subconical and resembling the halves of a walnut shell, the lower always persistent, the upper always deciduous; corolla bright red, yellow, white tinged with rose, dark violet, violet-blue, or pallid and variously marked, chiefly on the lower lip, the tube cylindrical, somewhat sigmoid (recurving-ascendent), or arcuate, or sometimes bent at right angles, usually hairy externally, glabrous within or variously hairy, even sharply annulate, the upper lip usually galeate or cupped, sometimes seemingly plane, usually obliquely joined to the lateral lobes of the lower lip; stamens ascending under the upper lip and included by it, the upper seated usually above the middle of the tube, the lower near the middle, or both sometimes seated near the base, one anther of each of the lower pair abortive; upper style branch small or wanting, appressed to the lower; nutlets ovoid, rarely obpyriform, elevated upon a postlike gynophore, tuberculate or verrucose or covered with pegs or squamellae, sometimes banded near the equator.

KEY TO THE SECTIONS

A. Low herbs (rarely half-shrubby) with small entire leaves mostly 1–2 cm. long which tend to be oval or rotund, less often oblong; flowers in the axils of the upper diminished but scarcely bractlike leaves.

  B. Corollas violet-blue (rarely pinkish, whitish or cream), not red.

    C. Corolla tube and galea 23–26 mm. long, the stamens seated 9–12 mm. above the base of the tube which is marked within by a narrow sharply defined oblique annulus near the mouth of the calyx (plants of Missouri; see also *Annulatae*) VI. SAXICOLAE

    CC. Corolla tube and galea 5–22 mm. long or if longer, plants of the Pacific Slope, the tube glabrous within or hairy, sometimes broadly annulate, but not as defined above.

      D. Upper lip of mature calyx broadly conical or pyramidal, not much deeper than the lower lip; nutlets notably obpyriform; plants of Antarctic America, spreading by rhizomes.....................II. ANTARCTICA

      DD. Upper lip of mature calyx compressed into an erect and transverse scutellum, notably different in form from the lower lip; nutlets subglobose.

        E. Plants perennial from a woody caudex (but annual in two species); plants of Texas and the north Mexican plateau (see also *Spinosae*) V. RESINOSAE

EE. Plants perennial from creeping rhizomes, often forming tubers (see also *Annulatae* and *Resinosae*); plants of the United States and Canada . . . . I. GALERICULARIA

BB. Corollas rose color, 20–25 mm. long; shrublets with rigid subspinose branches (see also *Perilomioideae*) . . . . IX. SPINOSAE

AA. Herbs or half-shrubs with leaves more or less toothed, rarely entire, usually longer than 2 cm. (*S. cardiophylla* annual).

B. Corollas blue or pinkish (sometimes appearing rose-color when dried), hardly red, white only as rare albinos.

C. Corolla tube and galea usually 18 mm. or more, rarely as little as 14 mm., marked within by a narrow, sharply defined oblique annulus near the mouth of the calyx; plants of the eastern United States . . . . VII. ANNULATAE

CC. Corollas glabrous within or hairy and sometimes broadly annulate, but not as defined above.

D. Plants producing stolons or spreading rhizomes; flowers opposite in the axils of the upper diminished leaves or in the axils of persistent bracts; plants chiefly of the eastern United States, one circumpolar, two tropical, one of northern Mexico.

E. Stolons or rhizomes very slender, filiform, scarcely 1 mm. in diameter; flowers usually in the axils of entire bracts (but see 20. *S. Churchilliana;* 21. *S. cardiophylla* is annual).

F. Scutellum impressed and concave; inflorescence or some part of stem viscid or at least sprinkled with spreading glandular hairs . . . . IV. MIXTAE

FF. Scutellum hardly impressed and not concave, pyramidal and subequal to the lower lip; inflorescence and stems hirtellous but sometimes bearing microscopic capitate glands, not at all viscid (see also 20. *S. Churchilliana*) . . . . III. LATERIFLORAE

EE. Stolons or rhizomes usually stouter; flowers usually axillary in the upper diminished leaves . . . . I. GALERICULARIA

DD. Plants not producing rhizomes nor stolons, the stems arising from a short caudex, often with fascicled fleshy roots; flowers usually not opposite but irregularly disposed in bracteate racemes, the bracts at length usually deciduous, less often in the axils of the upper diminished leaves; plants of tropical America . . . . VIII. ULIGINOSAE

BB. Corollas red, reddish-purple, orange, or yellow, rarely pallid, rarely marked with blue; plants of tropical or subtropical America.

C. Flowers strictly opposite, subtended by bracts and disposed in short racemes which are often axillary.

D. Corollas externally glabrous; Chilean half-shrubs . . . . . XVIII. THERESA

DD. Corollas externally hairy.

E. Lower stamens seated below the middle near base of corolla tube; Andean half-shrubs or herbs.

F. Upper lip of calyx cupped at maturity and similar to the lower lip, not produced into a squama . . . . XVII. PERILOMIA

FF. Upper lip of calyx bearing the usual squama (except *S. volubilis* and *?S. tomentosa*) . . . . XVI. PERILOMIOIDEAE

EE. Lower stamens seated near the middle of the tube or above; Mexican herbs or half-shrubs.

F. Herbs with creeping thickish rhizomes; corollas red, 33–34 mm. long . . . . X. CRASSIPEDES

FF. Small half-shrubs with spinose branchlets, the stems arising from a woody caudex; leaves entire; petioles 1–2 mm. long; corollas red, about 23 mm. long . . . . IX. SPINOSAE

FFF. Half-shrubs with yellowish flowers in short axillary racemes; leaves irregularly crenate; petioles 3–10 mm. long................XV. LUTEAE

CC. Flowers disposed irregularly in bracteate racemes, not strictly opposite, often subverticillate; Mexican or Andean herbs or half-shrubs.

D. Corollas pallid, the lower lip sometimes blue.................XI. PALLIDIFLORAE

DD. Corollas red or golden, sometimes white and rosy, sometimes red, marked with blue.

E. Leaves equally and softly pubescent on both surfaces; herbs..XII. SPECIOSAE

EE. Leaves usually with a few coarse hairs on the upper surfaces, hirtellous on the veins beneath, or quite glabrous.

F. Half-shrubs arising from a short caudex, apparently without fascicled roots; corolla tube usually arcuate; two species with elliptical leaves South American, the remainder North American.....XIII. CARDINALES

FF. Herbs with fascicled fleshy roots (see also *Pallidiflorae*); corolla tubes usually straight; South American plants..............XIV. COCCINEAE

SECTION I. **Galericularia**

Galericularia A. Hamilt., Monogr. Scut. 30, 1832, and Benth., Lab. Gen. et Sp. 436, 1834. The type species may be taken as *S. galericulata.*

Low herbs with creeping perennial rootstocks which sometimes form tubers, the annual stems erect, branched or simple, rarely more than 50 cm. tall, usually less. Lower leaf blades generally ovate and petiolate, the median and upper frequently oblong or even linear and subsessile, all sometimes ovate-oblong and subsessile. Flowers axillary in the upper more or less diminished leaves; upper lip of calyx clearly compressed and usually cupped. Corolla blue or dull white, rarely yellowish or marked with yellow, the lower lip spreading and deflexed, the lower stamens seated usually near the middle of the tube, less often below it, the tube hairy within or glabrous, but not annulate. Nutlets tan or buff, more commonly black, variously verrucose or covered with peglike processes, frequently bearing a smooth band at the equator and thus resembling a stemless mushroom.

The species of this section, as it occurs in the United States and excluding *S. galericulata,* are apparently of two alliances (see fig. 2): of the East and of the West. The eastern alliance is homogeneous and suggests an origin from a single complex; the western is more diverse and confused in relationships. *S. galericulata* occurs in both regions.

Three Californian species, *S. Bolanderi, S. nana,* and *S. tuberosa* diverge notably from the other members of this section, either of the western or eastern United States. Their morphological attributes suggest a different origin for each. To these species may be added *S. stachyoides* of Sonora, known from a single collection. This species resembles and may form an alliance with *S. tuberosa. S. Bolanderi* is unique among the North American species in the position of the lower stamens, which are below the middle of the tube; it is distinct in foliage and pubescence. *S. californica* and *S. antirrhinoides,* both chiefly Californian, suggest a possible hybrid connection with *S. Bolanderi* and the phylad containing *S. Austinae*. I have seen *S. antirrhinoides* and *S. Austinae* growing together in several regions but have seen no evidence of hybridization between them. Nevertheless, throughout the range of *S. antirrhinoides* forms occur which are almost indistinguishable from forms of

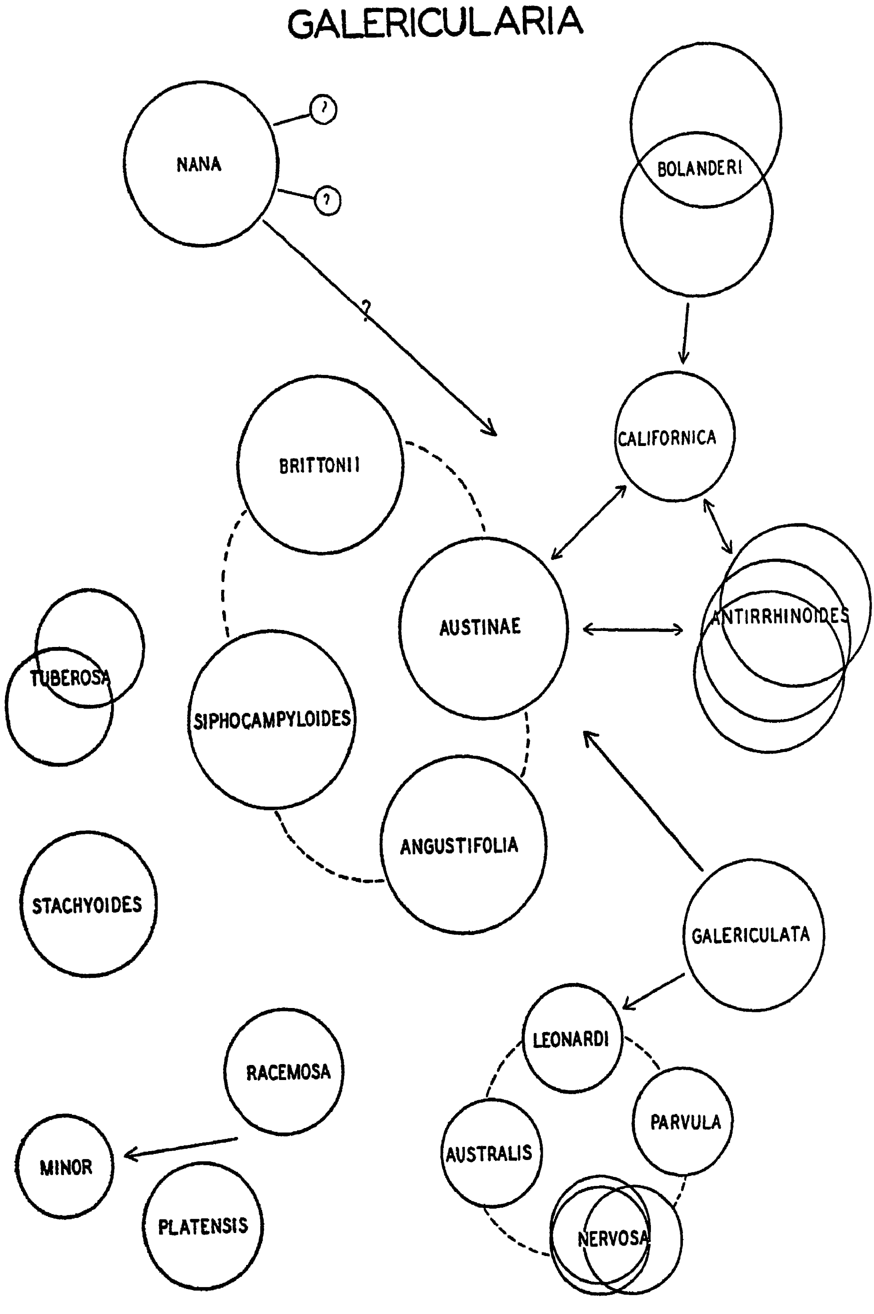


Fig. 2. Possible relationships between the species of *Galericularia.* Overlaps indicate species represented by two or more subspecies. Broken lines indicate two closely integrated phylads. Arrows show possible past genetic connections. The two small circles near *S. nana* refer to *S. Footeana* and a blue-flowered form (see p. 30, under *S. nana*).

S. Austinae. At the same time it is difficult to distinguish between *S. antirrhinoides* and *S. californica* in the absence of flowers. The corollas themselves are more or less intermediate, and that of *S. californica* strongly suggests that of *S. Bolanderi. S. antirrhinoides* has a range in flower size unusual for this section and not unlike that found in some species of *Resinosae.*

The remaining eight species of *Galericularia* in the United States (excluding *S. galericulata*) form two narrow phylads interesting to contrast. In the western United States are four forms which have centered around *S. angustifolia* in systematic treatment. In the eastern United States are four forms similarly centered around *S. parvula.* Both phylads are probably connected in some way with *S. galericulata.* Except for *S. nervosa,* all parts of which are significantly larger than in its immediate allies, the size and conformation of the flowers, but for slight modal differences, are nearly the same within each of the two phylads. Foliar and pubescence characteristics are therefore the only means of segregation within each phylad. In the minutiae of pubescence within each phylad (see plate 1) four lesser categories can be defined. Each pubescence type has a geographic range different from that of its associates, and correlated with vegetative habit.

The leaf habit of each of these two phylads can be visualized as a continuous curve of variation in which there are four strongly developed modes. No single leaf characteristic distinguishes any one of the forms. However, the degree to which each is grouped about a different center is such that an experienced investigator, upon inspection of the habit, can rapidly and effectively segregate a large series of specimens. The groups thus obtained correspond closely with the pubescence categories.

The following tables show measurements of median leaves of each pubescence form, the ratio of breadth to length, the absolute lengths and breadths, comparison of the means of each, and the statistically significant differences thus obtained (see tables and figs. 3, 4):

MEDIAN LEAVES

Species	Number Measured	Length in mm.		Breadth in mm.		Breadth: length	
	N	M	σ	M	σ	M	σ
S. angustifolia...........	86	21.0	4.2	6.4	1.5	.313	.068
S. siphocampyloides......	40	28.0	6.2	5.0	1.5	.188	.046
S. Austinae.............	71	22.0	5.5	3.7	1.1	.168	.037
S. Brittonii.............	74	24.5	5.0	8.0	2.0	.328	.059
S. nervosa...............	73	33.5	5.5	21.0	4.5	.630	.080
S. Leonardi..............	75	13.0	1.9	5.5	1.1	.400	.065
S. australis.............	76	13.0	2.0	8.5	1.7	.641	.103
S. parvula...............	73	13.3	2.5	7.5	1.6	.543	.070

The following table shows comparison of pairs of species with respect to length, breadth, and ratio of breadth to length in terms of standard errors

$$\frac{\mathrm{m}_1 - \mathrm{m}_2}{\sqrt{\sigma^2_{\mathrm{m}_1} + \sigma^2_{\mathrm{n}}}}$$

Species	*S. Brittonii*			*S. Austinae*			*S. siphocampyloides*		
	L	B	B:L	L	B	B:L	L	B	B:L
S. angustifolia...	4.8	5.7	4.8	1.4	14.2	17.0	6.5	5.0	12.2
S. Brittonii......	...	...	...	3.0	17.2	19.7	3.1	9.1	14.0
S. Austinae......	...	...	...	...	...	...	5.3	5.0	2.4

Species	*S. parvula*			*S. Leonardi*			*S. nervosa*		
	L	B	B:L	L	B	B:L	L	B	B:L
S. australis.....	.8	3.7	6.9	0.0	13.1	17 2	30.1	22.3	0.8
S. parvula.......	...	...	...	.8	8.7	12.8	28.9	24.6	7.0
S. Leonardi......	...	...	...	...	...	...	30.1	28 7	19.1

The significance level is taken as 3.0.

These data show that *S. Austinae* and *S. siphocampyloides* present but little difference (2.4) in leaf proportions; but if *S. Austinae* is compared with *S. angustifolia* or *S. Brittonii,* the differences are strongly significant (17.0 and 19.7, respectively). The difference between mean lengths of *S. Austinae* and *S. angustifolia* is not significant (1.4) but is significant with respect to breadth (14.2). Comparisons made from these data (see figs. 3 and 4) suggest that the genetic factors which determine leaf shape and size are different in each of the categories under consideration. But the differences are not all of the same magnitude.

The geographical ranges of the four eastern categories thus derived are partially sympatric (see map 3); those of the western categories are largely allopatric. In the East, two pubescence forms frequently occur in the same locality, suggesting, therefore, the possibility of interchange of pollen. Constancy of pubescence, however, indicates that hybridization is not now taking place, or if so, but rarely, particularly since the mean vegetative habit of a pubescence form is the same in these areas which are shared with another form as in those areas where it alone occurs. Specific segregation of these categories is therefore strongly indicated, and I have followed that course. Inasmuch as the morphological gaps between the western categories are of about the same magnitude as those between the eastern species, I have preferred to consider each of these also as specifically distinct. This conclusion is reinforced by the overlapping ranges, without any apparent intergradation, of two categories in the Sierra Nevada. The geographic separation in the West is perhaps resultant from the broken terrain and its effect upon migration.

Each of the eight species thus distinguished is fairly uniform. Those of the eastern United States show a considerable variability in leaf outline. The

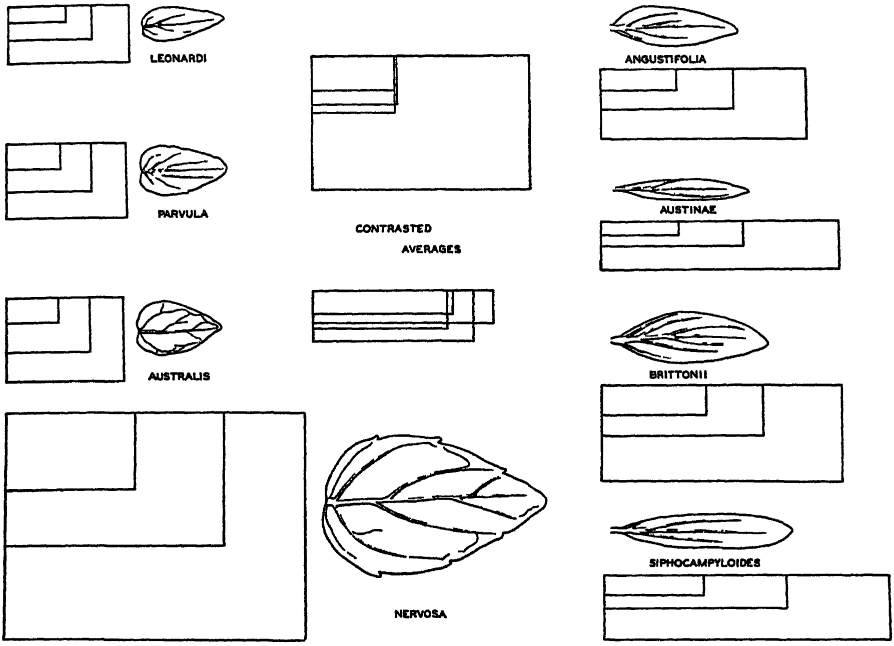


Fig. 3. Comparison of the maximum, minimum, and mean sizes of the median leaves of (*right*) *S. angustifolia, Austinae, Brittonii,* and *siphocampyloides* and (*left*) *Leonardi, parvula, australis,* and *nervosa.* In the center are the contrasted averages of both (arithmetic means).

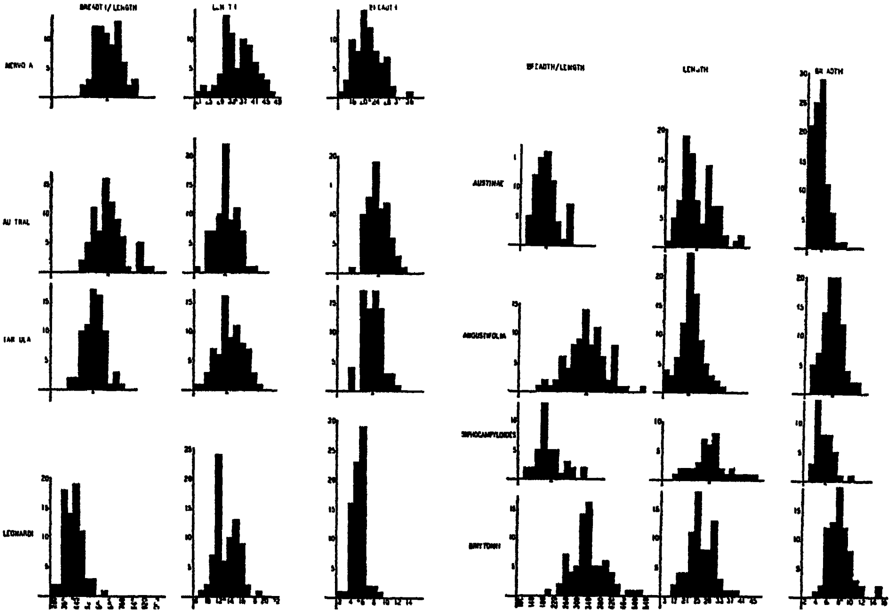
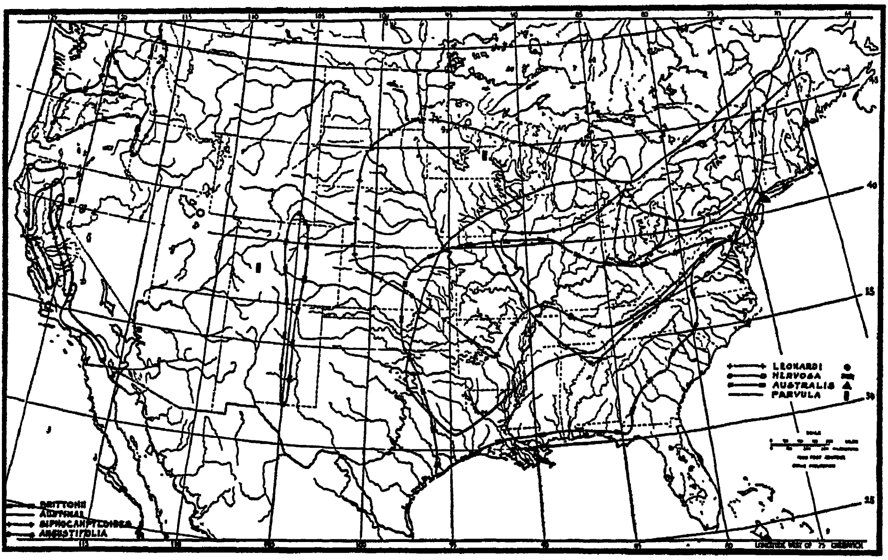


Fig. 4. Differences in length, breadth, and the ratio of breadth to length, of median leaves in eight species of *Galericularia.* Horizontal scales are shown at the bottom of each column, except for *S. nervosa.*

modal characteristics are different, however, and correspond to the modes of proportion. The differences in pubescence are constant, with but few intermediates. It has also been observed that the stomata of *S. Leonardi* are constantly larger than those of the three other eastern species, and that its epidermis presents a recognizable pattern. The stomata of the other three species appear to vary. Each species of the western United States is more constant in leaf form. The pubescence of *S. Brittonii* is variable, however, and the leaf size of *S. Austinae* has a certain degree of geographic variation, for the plants of southern California are uniformly narrower-leaved than those of the Sierra Nevada and northern California.



Map 3. Approximate limits of distribution of eight species of section *Galericularia*. Bars indicate extralimital stations for *S. Brittonii* in western Colorado and *S. parvula* in western Wisconsin.

Only a general connection seems to exist between *S. racemosa* and the *Galericularia* phylad of the eastern United States; moreover, *S. racemosa* seems to be more directly allied to *S. minor* and *S. hastaefolia* of Europe than to any of the North American species. *S. platensis* is possibly a derivative of *S. racemosa* or an allied form.

KEY TO THE SPECIES

A. Galea plus tube of corolla 5–10 mm. long.

B. Entirely glabrous plants with the lower leaves deltoid or hastate; plants of tropical North America and South America.

Lower leaves hastate, otherwise entire, resembling those of *Rumex Acetosella* 2. **S. racemosa**

Lower leaves deltoid or deltoid-ovate, dentate.................. 3. **S. platensis**

BB. Puberulent or pubescent plants, rarely quite glabrous, the lower leaves ovate or deltoid-ovate; plants of the Mississippi-Ohio drainage and lands eastward in the United States and Canada.

C. Stems appearing glabrous, the pubescence of the upper parts ascending, the hairs curled or appressed, not at all glandular.
    D. Median leaves 20–40 mm. long; galea and tube of corolla 8–10 mm. long **4. S. nervosa**
    DD. Median leaves 10–15 mm. long; galea and tube of corolla 6.5–9 mm. long (see also note to *S. australis,* concerning a form from eastern Texas) **5. S. Leonardi**
CC. Stems clearly hairy with glandular or eglandular spreading hairs or both.
    D. Hairs of upper part of the stems both ascendent and eglandular, and (mostly) spreading and glandular; veins tending to anastomose along the leaf margins; lower leaf surface with glandular hairs only **6. S. australis**
    DD. Hairs of upper part of stems spreading or retrorse and eglandular or glandular; veins usually unbranched along margins; lower leaf surfaces clothed like the stems................................**7. S. parvula**

AA. Galea plus tube of corollas 12–32 mm. long; plants of the western United States except one species which is circumpolar and one which is Mexican.
  B. Palate entirely glabrous, a few long hairs sometimes scattered within the corolla tube (see also 8. *S. tuberosa*).
    C. Galea and tube of corolla 14–21 mm. long; median leaves truncate-subcordate; circumpolar plants (see also 11. *S. Bolanderi* in California) .**1. S. galericulata**
    CC. Galea and tube of corolla 23–32 mm. long; median leaves narrowed toward the base; plants of Wyoming, Colorado, and New Mexico.......**15. S. Brittonii**
  BB. Palate clearly pilose; plants of the Pacific Slope, chiefly Californian, one Sonoran.
    C. Stem pubescence of spreading, sometimes viscid hairs 0.5 mm. long or more; corolla tube and galea 12–21 mm. long; all leaves more or less toothed.
      D. Californian plants.
        E. Corolla whitish, the lower lip flecked or tinged with violet; median leaves prevailingly 2–5 cm. long, subtruncate at the base; nutlets verrucose, banded near the base..................**11. S. Bolanderi**
        EE. Corolla evenly violet; median leaves prevailing 1–2 cm. long, narrowed or rounded at the base, not at all truncate; nutlets coarsely and irregularly toothed or pegged, not banded........**8. S. tuberosa**
      DD. Sonoran plants not unlike *S. tuberosa;* petioles, even the lower, 3 mm. long or less...................................**9. S. stachyoides**
    CC. Stem pubescence of curled appressed hairs, or if spreading, the galea and tube 24–30 mm. long; leaves entire or nearly so, at least those above the middle of the stem.
      D. Stem pubescence curled downward and closely appressed.....**10. S. nana**
      DD. Stem pubescence curled upward or spreading, sometimes retrorse but not closely appressed.
        E. Corolla tube and galea 12–22 mm. long, the throat completely closed by the appressed palate.
          F. Length of corolla tube below point of attachment of lower stamens 5–8 mm., commonly about 6 mm., the lower filaments 10–14 mm. long, the free portion of the filaments usually about twice as long as the corolla tube below point of stamen attachment; corolla yellowish or white..................**12. S. californica**
          FF. Length of corolla tube below point of attachment of stamens 5–11 mm., commonly 8–9., the lower filaments 7–11 mm. long, commonly about 9 mm. long, the free portion of the filaments usually about equal to the tube below the point of stamen attachment; corolla usually blue..............**13. S. antirrhinoides**
        EE. Corolla tube and galea 20–32 mm. long, the throat open between the galea and lower lip.

F. Stems hirtellous with short upwardly curled hairs, these rarely replaced by spreading capitate glands in the Snake River region, or rarely glabrous.
  G. Median leaves narrowly ovate or elliptical, 3.5–11 mm. broad, averaging about 6.5 mm.; plants of Oregon, Washington, and Idaho..............14. **S. angustifolia**
  GG. Median leaves oblong, 2–7.5 mm. broad, averaging about 4 mm.; plants of California...17. **S. Austinae**
FF. Stems clothed with spreading hairs which are both glandular and eglandular, the eglandular hairs directed either somewhat upward or downward ....16. **S. siphocampyloides**

1. **S. galericulata** L. Sp. Pl. 599, 1753.—

S. epilobiifolia A. Hamilt., Ann. Soc. Linn. Lyon 1: 32, 1832; type a plant in the DeCandolle Herbarium, collected by Bigelow (Paris).

S. galericulata var. *pubescens* Benth., Lab. Gen. et Sp. 437, 1834 (no type designated, but clearly the common American form, which, as Bentham also noted, apparently occurs in the Altai region).

S. g. var. *vulgaris* Benth., l.c. (no type designated but clearly the European form referred to in this paper).

S. g. var. *glaberrima* Benth., l.c. (type collected by Douglas in Washington [Kew]); the glabrous form referred to in this paper.

S. g. forma *rosea* Rand and Redfield, Fl. Mt. Desert, 137, 1894.

S. epilobiifolia forma *rosea* Fern., Rhodora 23: 96, 1921.

S. g. forma *albiflora* Millsp., Fl. W. Va. 428, 1892.

S. epilobiifolia forma *albiflora* Fern., Rhodora 23: 96, 1921.

A perennial paludose herb, spreading by slender stolons, its stems prevailingly 30–60 cm. tall, either simple or branching, especially when procumbent or lodged, usually pubescent with small curled hairs, at least along the acutish angles, rarely glabrous or sparingly sprinkled with slender capitate glandular hairs, the median internodes mostly shorter than the leaves; leaf blades borne on rather broad petioles 1–3 mm. (rarely as much as 6 mm.) long, gradually diminished above the middle of the stem, the median for the most part 3–5 cm. long, 1–2.5 cm. broad, ovate-oblong, squarish below the middle and truncate-subcordate, narrowed above the middle to the usually acute apex, their margins crenate-serrate, the upper surface nearly smooth, sparingly hispidulous, the lower paler, evenly puberulent with small curled hairs, rarely nearly glabrous or puberulent only on the veins; flowers solitary in the axils of the upper diminished leaves, borne on retrorse hirtellous pedicels 2–2.5 mm. long at maturity; corolla blue, the tube and galea 14–21 mm. long, commonly about 17–18 mm., the galea 9–11 mm. long, commonly about 10 mm., the lower stamens seated 8–10 mm. above the base; nutlets light brown, verrucose.

The name *S. epilobiifolia* of A. Hamilton was taken up by Fernald (Rhodora 23: 85, 1921) to designate the American homolog of the Eurasian *S. galericulata*. This action was based upon presumed differences in corolla size and color, differences in the degree of pubescence, the fact that the leaves of the American plants are more cordate at the base than the Eurasian, and particularly upon the differences in size and pattern of the nutlets. After examination of a very large series of specimens from most of the larger American herbaria, I have found that these conclusions may be sustained only in part.

It is impossible to determine finally either from herbarium specimens or published plates, the differences in corolla color. So far as recent and well-prepared specimens from both regions indicate, the differences are not significant, and seemingly the variation in pattern is about the same in both. Nothing can be said about the conformation of the lips.

Though the degree of pubescence is uniform in most of the American collections, quite glabrous forms, not otherwise different, have been collected in Crook and Deschutes counties, Oregon, and Grant and Okanogan counties, Washington. Occasional nearly glabrous forms also occur in the eastern United States. At the same time specimens from Siberia and Turkestan, and occasionally from western Europe, show pubescence as dense as or denser than the specimens of the United States. The range of variation of pubescence on the two continents cannot therefore be said to differ significantly.

The leaf shape and habit have about the same range of variation on both continents.

In corolla size, however, certain modal differences do appear. Length of the corolla (galea plus tube of boiled dissected specimens) of the comparatively few Eurasian specimens available ranges from 13 to 18 mm., averaging approximately 15 mm. For the American specimens the length lies between 14 and 21 mm., the average being about 17.5 mm.

As suggested by Fernald, the nutlet pattern presents a modal difference, but not of sufficient sharpness, however, to permit geographic segregation. The range in size is about the same. So far as one can judge in those specimens where they have been preserved, the nutlets may frequently form a rather variable pattern within a given species. Or species which are otherwise similar may produce rather different nutlets, as for example the species of section *Resinosae*. On the other hand, several species with similar and distinctive flowers, as in section *Annulatae,* may have similar nutlets. It would appear, therefore, that the deductions made by Penland (Rhodora 26 : 61, 1924) were based upon an inadequate series of nutlets, and that too much importance was attached by him to this single characteristic.

After comparing a large series of specimens of this complex I have concluded that the species is fairly stable in North America, except for the glabrous variants mentioned above, and that it is more variable in Eurasia, suggesting the presence there of two races, an eastern and a western. Of these, the eastern form seems scarcely distinguishable from the American. At the same time individuals gathered in Sweden seem scarcely distinguishable from the eastern Eurasian form or the American. Accordingly, there seem as yet no satisfactory grounds for segregating the American form, as done by Hamilton and Fernald.

This species is general and apparently abundant throughout the immediate drainage of the Great Lakes and St. Lawrence River, both in Canada and in the United States, particularly where swamps and lakes occur. Its extent and abundance northward is not clear since most of the collections, as might be expected, have come from the well-settled areas to the south. However, the nature of its habitat, its occurrence in Alaska (Alaska Range near Paxons), in the Mackenzie District, and in northern Alberta, as well as its frequence in southern British Columbia, suggest that it is general throughout the lake and swamp region of northern Canada. In the United States it is general and common throughout the New England States and New York, in Michigan, Wisconsin, and Minnesota. While local in the northern Rocky Mountains, it appears to be largely absent from the plains states. Its range within the United States, exclusive of those states where it is general, may be indicated by counties as follows; in most of these regions, particularly in the western states, its occurrence is evidently infrequent:

Distribution (see map 2).—ARIZONA. Apache: White Mountains; Navajo: Lakeside. CALIFORNIA. Nevada: Truckee; Placer: Lake Tahoe; Plumas: North Fork Feather River; Shasta: Fall River Lake. COLORADO. Archuleta: Pagosa Springs; Boulder: Lyons, Boulder; Chaffee: Buena Vista; Costilla: San Luis Valley; Delta: Hotchkiss; Denver: Denver; Dolores; El Paso: Cascade, Broadmoor; Freemont: Canon City; Gunnison: Parlin, Gunnison; Jefferson: Golden; Larimer: Fort Collins, Cache de Poudre River, Estes Park; Las Animas: Trinidad; Ouray: Ouray; Weld: Pawnee Creek. DELAWARE. New Castle. FLORIDA. Leon. IDAHO. Bear Lake: Montpelier; Bonner; Boundary; Clearwater: Pierce, Orogrande Creek; Fremont: St. Anthony; Kootenai; Latah: Potlatch. ILLINOIS. Cass, Cook, Du Page, Lake, Peoria, Rock Island, Stephenson. INDIANA. Elkhart, Floyd, Fulton, Jasper, Johnson, Kosciusko, La Grange, Lake, LaPorte, Marshall, Newton, Noble, Porter, Pulaski, Starke, St. Joseph, Steuben, Wells, White, Whitley. IOWA. Cedar, Dickinson, Emmet, Fayette, Hancock, Kossuth, Story. MISSOURI. Dukes, Jackson. MONTANA. Belgrade; Carbon: Red Lodge; Cascade: Great Falls; Deerlodge: Deerlodge; Flathead: Big Fork; Gallatin: Flathead Creek; Lake: Swan Lake; Lewis and Clark: Wolf Creek, Helena; Logan: East Gallatin Swamp; Missoula: Frenchtown, Fort Missoula; Sedan. NEBRASKA. Buffalo, Dawson, Franklin, Garfield, Holt, Kearney, Platte, Scotts Bluff, Stanton, Thomas. NEW JERSEY. Camden, Hudson, Hunterdon, Morris, Sussex. NEW MEXICO. Colfax: The Park; San Juan: Farmington. NORTH DAKOTA. Barnes, Benson, Bottineau, Foster, Pembina, Rolette. OHIO. Anglaize, Ashtabula, Cuyahoga, Erie, Lake, Licking, Lorain, Lucas, Portage, Trumbull. OREGON. Crook: Laidlow; Deschutes: Tumalo; Harney: Malheur Lake; Klamath: Aspen Lake, Upper Klamath Lake, Midland; Marion: Brooks; Multnomah: Portland, Clackamas Lake; Union: Hilgard, La Grande. PENNSYLVANIA. Bradford, Chester, Clarion, Columbia, Crawford, Delaware, Erie, Lackawanna, Luzerne, Monroe, Northampton, Pike, Sullivan, Wayne. SOUTH DAKOTA. Black Hills. UTAH. Morgan: Peterson; Salt Lake: Murray, Salt Lake; Sevier: Fish Lake; Utah: Carterville, Provo River, Provo; Weber: Ogden Canyon. VIRGINIA. Alexandria: Brickhaven. WASHINGTON. Chelan: Nason Creek; Grant: Coulee City; Island: Whidbey Island; King: Seattle; Lincoln: Wilbur; Okanogan: Black Mountain, Omak Creek, Tonasket; Pacific: Ilwaco; Pierce: Lake 25 miles south of Tacoma; San Juan: San Juan Islands, Orcas Island, Olga; Spokane: Spokane, Marshall Junction; Stevens: Loon Lake. WYOMING. Albany, Laramie, Lincoln: Jackson Hole; Park: Crow Creek; Uinta: Jackson Lake.

2. **S. racemosa** Pers., Syn. Pl. 2: 136, 1807; type collected by Commerson near Montevideo, Uruguay (Paris, Jussieu Herb.).

S. rumicifolia Kunth, *in* Humboldt and Bonpland, Voy., Nov. Gen. et Sp. Pl. 2: 324, 1817; type collected by Bonpland near Jalapa, Mexico (Paris).

S. heterophylla and *S. bonariensis* Willd. ex Benth., Linnaea 11: 345, 1837.

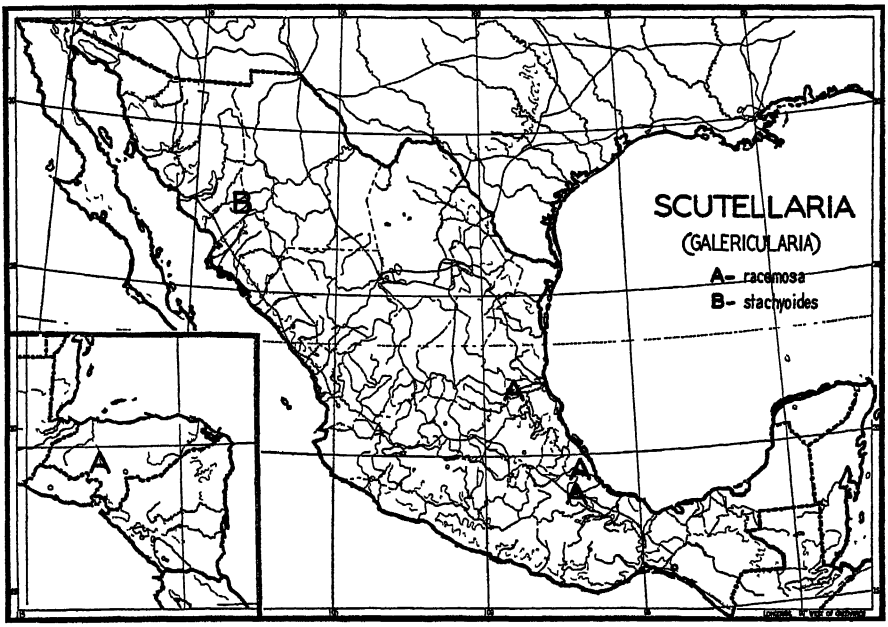
S. Rojasii Briq., Bull. Herb. Boiss. ser. 2, 7: 600, 1907; type collected by Rojas (no. 171) along the Rio Pilcomayo in Paraguay (Deless.).

S. hastata Larranaga, Escr. D. A. Larranaga, Publ. Inst. Hist. Geogr. Urug. 2: 187, 1923.

A perennial entirely glabrous herb 10–30 cm. tall with usually weak often decumbent stems and spreading slender rhizomes; leaves diverse in size and form, the lowermost hastate or deltoid, 1–4 cm. long, 1–2.5 cm. broad, thin, borne on petioles 3.5 mm. long, the median and upper gradually diminished, sessile or subsessile, narrowly hastate or linear-lanceolate, especially the uppermost, or even linear, scarcely 1 mm. wide, all entire and rather obtuse at the apex; flowers solitary in the axils of the median and upper diminished leaves, borne on pedicels 2–4 mm. long; flowering calyces 1.5–2 mm. long, somewhat enlarged at maturity;

corolla violet, rose, or pallid, the galea and tube 5–6.5 mm. long, hirtellous within, even subannulate, the lower stamens seated about 2 mm. above the base of the tube; nutlets fuscous, tuberculate.

This species occurs widely in tropical America, from Vera Cruz to Valdivia. It is impossible to say to what extent it is native to these regions and to what extent introduced. If introduced, it appears to have become well naturalized. While clearly marked and readily recognized, it is quite variable in habit of foliage, possibly in response to conditions of drought or shade. It is similar in many ways to *S. minor* and *S. hastaefolia* of Europe and strongly suggests an alliance with these species. If so, it is the only South American species of Labiatae which shows a direct alliance with species of Eurasia. At the same time, small strict forms, which appear to be sun forms, are suggestive of *S. Leonardi* of the eastern United States. It is collected more frequently in southern Brazil, Uruguay, Paraguay, and adjacent Argentina, than elsewhere.



Map 4. Distribution of section *Galericularia* in Mexico and Central America.

Distribution (see maps 4, 5).—MEXICO: VERA CRUZ. Jalapa *Scheide* 105; *Pringle* 7763; Huatusco *Mohr* 339; between Misantla and Naolinco *Purpus* 6040. SAN LUIS POTOSI. Las Canoas *Pringle* 3067. JALISCO. Rio Blanco near Guadalajara *E. Palmer* 96. CHIAPAS: Fenix *Purpus* 468, 10469.

HONDURAS. Comayagua, Siguatepeque *Standley* 55964, 56035, 56486.

COLOMBIA: CUNDINAMARCA. Bogota *Tracy* 440; *Pennell* 2159; *Linden* 108, 203, 803; *Lehmann* 6364; *Holton* 488; *Hartweg* 1341.

ECUADOR: LOJA. Loja *Bonpland.*

BOLIVIA. ? Yapac *Kuntze.*

CHILE: CAUTIN. Temuco *Claude-Joseph* 1884. VALDIVIA. Panguipulli *Claude-Joseph* 2701; Bellavista *Lechler* 327. ACONCAGUA. Valparaiso *Cuming* 754. CHILOE. Ancud *Barros* 42; *Pennell* 12519.

BRAZIL: MINAS GERAES. Rio Novo *Schwacke* 10940. SAO PAULO. Mooca *Brade* 6011; Iguape *Löfgren and Edwall;* Sao Paulo *Hoehne;* Butantan, *Gehrt;* Iguape *Edwall* 2678. PARANA. Ypiranga *Dusen* 16134; Tres Barras *Dusen* 17541; Pinhaes *Dusen* 13365; Rio Tibagy *Dusen* 7539; Curityba *Dusen* 8748. STA. CATHARINA. In campos *Glaziou* 19701. RIO GRANDE DO SUL. Rio Pardo *St. Hilaire;* Porto Alegre *Malme* 162; *Gaudichaud* 567, 568; *Reineck.*

PARAGUAY. Near Paraguari *Lindman* 3885; Asuncion *Balansa* 1012; Itira *Hassler* 580; Asuncion *Morong* 826, 58; Cordillera de Altos *Fiebrig* 209, 167; Concepcion *Hassler* 7478; Villarica, *Jörgensen* 3715; San Bernardino *Hassler* 2102, 1260, 3542; Ipetui *Hassler* 5579; Rio Pilcomayo *Rojas* 171, 235; Encarnacion *Rojas* 1376.

ARGENTINA: FORMOSA. Formosa *Jorgensen* 2830. CHACO. Las Palmas *Jörgensen* 2238; Colonia Benitez *Schultz* 13. CORRIENTES. Without locality *Bonpland.* MISIONES. Cord. de Misiones *Niederlein* 1846; Concepcion *Lorentz* 372; 1767; La Granja *Ekman* 1839; Santa Ana *Spegazzini* 1649. SANTA FE. Reconquista, Ocampo *Venturi* 281. BUENOS AIRES. Delta del Parana, Rio Chana *Scala* 102; in pampas *Meirs* 1069. Rosas, El Toro *Daguerre* 195; El Rio del Lola *Gillies.* CORDOBA. Las Quintas *Galander;* Estancia Germania *Lorentz* 44; Sierra Chica *Hieronymus;* Sierra Achala *Hieronymus;* Cordoba *Hieronymus* 53. SALTA. Without locality *Kuntze.* JUJUY. Jujuy *Lorentz and Hieronymus* 1003; Agua Blanca *Fries* 92*a;* Quinta, Laguna de la Brea *Fries* 92; Ledesma *Spegazzini* 1846. TUCUMAN. El Puestito *Venturi* 3604; Cruz Alta *Bailetti* 43; Tucuman *Lorentz and Hieronymus* 1137; *Scheiter* 52; Siambon *Venturi* 3604; Burruyacu *Monetti* 3011; Tucuman *Lillo* 387; Santa Ana *Baer* 86; Siambon *Hieronymus and Lorentz* 1135; Tafi *Venturi* 467; Famailla *Venturi* 2188; Yerba Buena *Venturi* 1130. CATAMARCA. Laguna Grande *Jörgensen* 1426; Singuil *Schickendantz* 71. SAN LUIS. Casa de Piedra *Galander.*

URUGUAY. Montevideo *Commerson; Herter* 374; *St. Hilaire* 2196; Santa Lucia *Smith* 57; *Safford; Fruchard;* Canelones *Rosengurtt* 1151.

3. **S. platensis** Speg. Com. del Mus. Nac. Buenos Aires 1: 320, 1901; type collected by Spegazzini (Dec., 1900) on the Isla Santiago, Rio de la Plata, Argentina (Buenos Aires).

An entirely or nearly glabrous herb 15–30 cm. tall, its internodes 1–5 cm. long; leaf blades deltoid-ovate, gradually diminished upwards, 10–30 mm. long, rather obtuse at the apex, *truncate-subcordate* at the base, *rather obtusely dentate along the margins with usually 6–12 teeth;* borne on petioles 3–15 mm. long; flowers solitary in the axils of the upper diminished leaves, borne on pedicels 3–5 mm. long; flowering calyces 2 mm. long, nearly glabrous, the lower lip 3 mm. long at maturity; corolla (?) blue or pallid, the galea and tube 5–6 mm. long, hirtellous within, the lower stamens seated 2 mm. above the base of the tube; nutlets apparently dark and finely granulose.

This species has been collected in company with *S. racemosa* on the Delta del Parana, Rio Chana, by *Scala.*

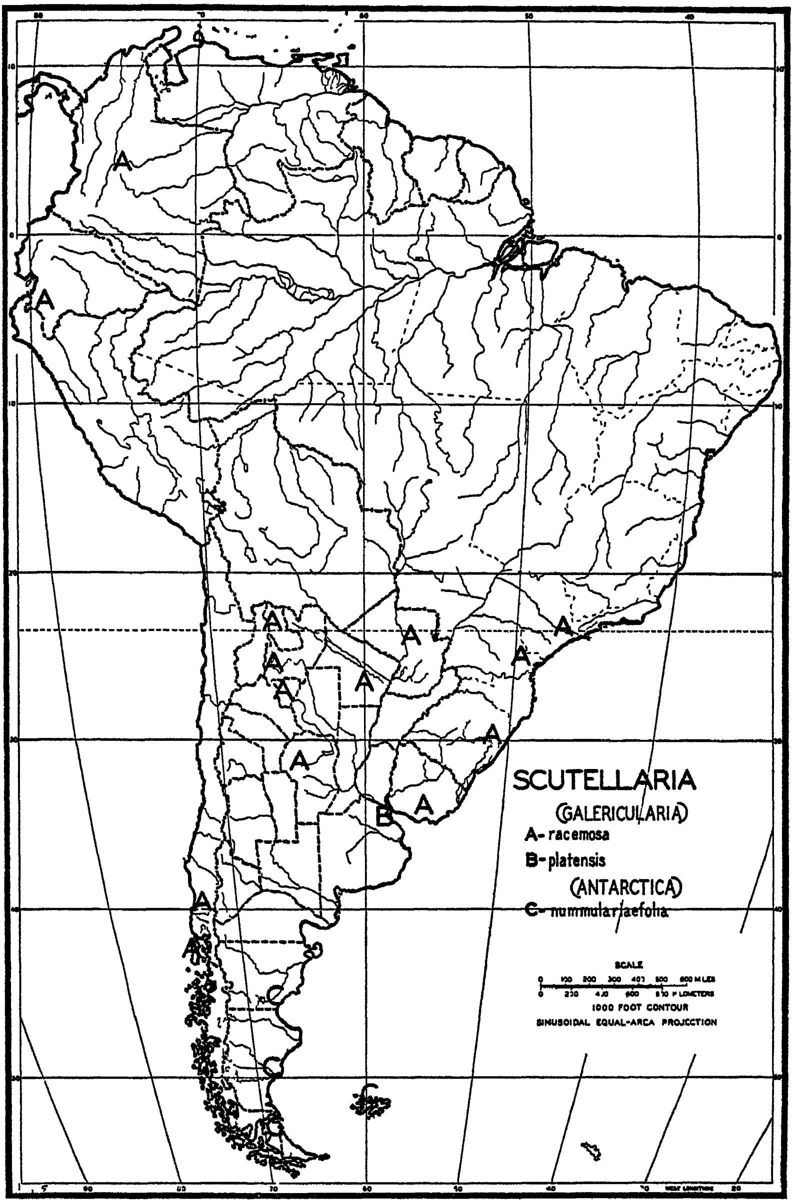
Distribution (see map 5).—ARGENTINA. Tamandra, Yabal, *Niederlein* 52. Delta del Parana, Rio Chana, *Scala* 101. Ribera del Rio de la Plata, Punta Lasa, *Cabrera* 2422. Delta del Parana, Rio Ceibo, Entre Rios, *Cabrera* 2514. Isla Santiago, *Speggazini.*

4. **S. nervosa** Pursh, Fl. Am. Sept. 412, 1814; Pursh's specimen (Acad. Sci. Phila.) is similar to plants which have been gathered near Washington, D. C., such as those by Kearney or Sheldon.

S. teucrifolia J. E. Smith, *in* Rees Cycl. 32, No. 15, 1816; a synonym, based upon the preceding.

S. gracilis Nutt., Gen. Pl. 2: 37, 1818; type collected by Nuttall on banks of Schuylkill near Philadelphia, Pennsylvania (Brit. Mus.); it represents apparently the same form as *S. nervosa.*

?*S. ambigua* Nutt., Gen. Pl. 2: 37, 1818; probable type or portion of it, collected by Nuttall in Ohio "in dry and open forests," in herb. of Acad. of Nat. Sci. Phila.; none in Brit. Mus. of Nat. Hist., but a fairly ample specimen of the same collection at Kew; this



Map 5. Distribution of sections *Galericularia* and *Antarctica* in South America.

specimen closely matched by Lloyd's collections from Cincinnati, and by those of Frank (1835) from same region.

S. parviflora Raf. ex Hamilt., Monogr. Scut. 37, 1832; type, collected by Rafinesque, fairly typical of *S. nervosa* (DC).

S. parvula var. *ambigua* Fern., Rhodora 3:201, 1901, refers to name only.

A perennial herb spreading by slender rhizomes, its stems now simple, now branching somewhat toward the base, sprinkled in the lowermost parts with spreading capitate-glandular hairs, in the upper parts with *upwardly curving appressed hairs chiefly along the* *angles,* sometimes wholly glabrous; blades of the lowermost leaves cordate-ovate, 1–1.5 cm. in diameter, sprinkled on both surfaces with spreading capitate glands, borne on petioles .5–2.5 cm. long, those of the median leaves generally ovate, sessile, 20–45 mm. long (*averaging about 35 mm.*), 12–36 mm. broad (*averaging about 20 mm.*), their margins *unevenly crenate-dentate,* those of the uppermost entire, the upper surfaces appressed-hirsute, especially toward the margins, the lower hirtellous along the veins with curving hairs; flowers disposed above the middle on pedicels which are ascendent-hirtellous; lower calyx lip 2.5–3 mm. long at flowering, 5–6 mm. long at maturity, hirtellous, the squama about 4 mm. tall, concave, *galea and tube 8–10 mm. long,* the lower lip hirtellous in two lines, the lower filaments seated below the middle of the tube; nutlets brown or nearly black, covered with peglike processes, usually banded.

S. nervosa presents two extremes of variation. The first, which may be called the typical, has ovate leaves and tends to be lax. The second, which has leaves tending to be deltoid, is more strict. These may be no more than shade and sun forms, such as may occur in the same colony of *S. Bolanderi,* which is similar in habit. However, occasional strict forms occur which suggest possible intermixture with another species, such for example, as *S. galericulata.* Such an anomalous form was gathered by Short at Blue Lick, Kentucky. It is not unlike an overgrown *S. Leonardi* in habit. *S. ambigua,* the type of which seems clearly connected with specimens collected near Cincinnati by Lloyd and by Frank, is another anomalous form which apparently falls within the range of variation of *S. nervosa.* The corollas would be definitive, but none are preserved. The pubescence of *S. ambigua* most nearly resembles that of *S. nervosa.*

Distribution (see map 6).—ONTARIO. Kingsville *Macoun* 54679.

DELAWARE. Perrys Tavern. DISTRICT OF COLUMBIA. ILLINOIS. Madison: *Eggert* in 1877, Marion, Menard, Richland: *Ridgway* 2916;[*] *E. J. Palmer* 15585; Saline: *Pepoon and Barrett* 5154; St. Clair: *Eggert* in 1893 and 1877; Tazewell. INDIANA. Adams, Allen, Bartholomew, Clark: *Deam* 6587; Dearborn, Dubois, Gibson, Greene: *Deam* 10689; Jackson: *Pennell* 11744, 11751; Jefferson, Harrison, Knox, Perry, Posey: *Deam* 8298; Switzerland, Warren, Wells. IOWA. Calhoun: Knoke; Van Buren: Stockport. KENTUCKY. Bourbon, Daviess, Fayette, Hancock: *E. J. Palmer* 17803; Kenton, Nelson, Robertson, Scott, Warren. LOUISIANA. Natchitoches: Red River. MARYLAND. Conowingo, Harford. MISSOURI. Boone, Dunklin, Knox, Shelby: *Palmer and Steyermark* 40879; St. Charles: *Steyermark* 541; St. Louis. NEW JERSEY. Hunterdon: Lambertville, Rocktown; Middlesex: Westons Mills, *Mackenzie* 7041; Passaic: Little Falls. OHIO. Delaware, Erie, Franklin, Hamilton: *C. G. Lloyd* 2062; Jackson, Jefferson, Licking, Lorain, Miami. PENNSYLVANIA. Adams, Allegheny, Beaver, Bedford, Berks, Bucks, Chester, Franklin, Lancaster, Montgomery, Philadelphia, Schuylkill, Snyder, Westmoreland. TENNESSEE. Benton, Decatur, Knox: *Ruth* 542, 525, 516; Montgomery: *E. J. Palmer* 17601. VIRGINIA. Fairfax: Dyke, Great Falls; Frederick: Winchester; Montgomery: Blacksburg; Rockbridge: Natural Bridge; Wythe: Wytheville. WEST VIRGINIA. Barbour, Fayette, Greenbrier, Kanawha, Monongalia, Ohio, Tyler, Upshur, Wetzel.

5. S. Leonardi Epl., Am. Jour. Bot. 26: 20, 1939.

S. ambigua Leon. and other authors, not Nuttall. As a standard specimen I am designating that collected by E. Palmer (May, 1899) near Mammoth Cave, Kentucky (Univ. Calif., L. A.).

S. parvula var. *ambigua* Fern., Rhodora 3: 201, 1901, excluding Nuttall's specimen; Nuttall's specimens at Philadelphia labeled "*Scutellaria parvula* or var.," consist of *S. australis* and *S. Leonardi.* Pursh's specimens of "*S. Parvula*" are *S. Leonardi.*

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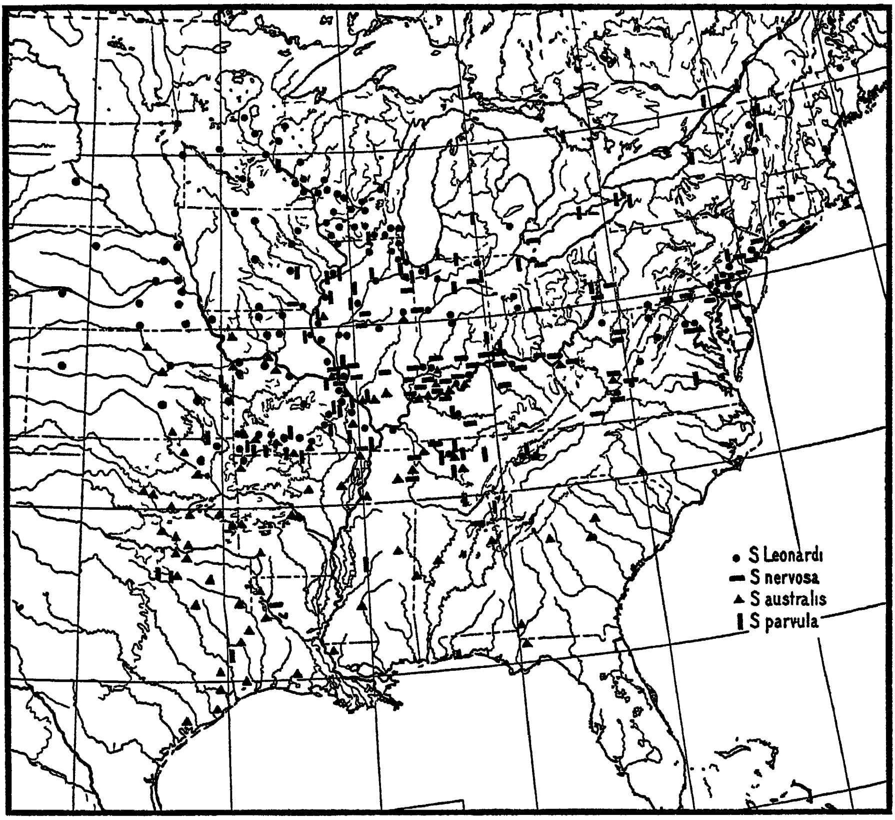
[*] Specimens which are representative and at the same time usually found in two or more herbaria are cited by number.

A small perennial herb creeping by moniliform rhizomes, its stems usually branched at the base, erect, generally 10–20, rarely 30 cm. tall, sprinkled in the lowermost parts with small spreading capitate glands, *elsewhere minutely appressed-hispidulous along the angles,* appearing glabrous, rarely completely so; lowermost leaf blades rotund-ovate, usually 4–8 mm. in diameter, sparingly hirsute on the upper surfaces, borne on petioles 3–8 or rarely 11 mm. long, the median 4–6 mm. broad (averaging about 5.5 mm.), 11–16 mm. long (averaging about 13 mm.), sessile, narrowly deltoid-ovate, *quite entire,* rarely irregularly dentate toward the base, glabrate on both surfaces, *being minutely appressed-hispidulous only toward the margins and somewhat revolute;* flowers disposed above the middle, the pedicels ascendent-hirtellous; lower lip of the calyx 2–3.5 mm. long at flowering, 4–5 mm. long at maturity, the squama 2–3 mm. tall, concave; galea and tube 6.5–9 mm. long, the lower lip hirtellous in two lines, the lowermost filaments seated near the middle of the tube; nutlets brown, covered with peglike processes, usually banded.



Map 6. Distribution of four species of section *Galericularia: S. Leonardi, nervosa, australis,* and *parvula.*

Throughout its range *S. Leonardi* is relatively constant and can readily be recognized by the nature of its pubescence as well as by the habit and shape of its leaves. It is readily distinguished by the pubescence from dwarfed forms of *S. parvula.* It resembles a diminutive of the strict forms of *S. nervosa* and frequently suggests a diminutive *S. galericulata.* It apparently occurs with *S. nervosa* in some regions.

This species frequently suggests both *S. minor* of Europe and *S. racemosa* of tropical America.

Distribution (see map 6).—ALABAMA. Jackson: Scottsboro. ARKANSAS. Benton, Lawrence: Denton; Pulaski: Little Rock. CONNECTICUT. New Haven: North Branford, East Haven; Tolland: Ellington. DELAWARE. Sussex: Rehoboth. DISTRICT OF COLUMBIA. GEORGIA. Floyd: Cobb. ILLINOIS. Champaign, Cook, DuPage, Hancock, Henderson, Jo Daviess, Kane, Kankakee, Lake, La Salle, Morgan, Ogle, Peoria, Pike, Randolph, Scott. INDIANA. Clark: Henryville, Charlestown; Crawford: Milltown; Daviess: Hyatt; Harrison: Elizabeth; Knox: Vincennes; Porter: Crisman; Starke: San Pierre; Steuben: Clear Lake; Tippecanoe: LaFayette; Tipton: Goldsmith. IOWA. Benton: Vinton; Black Hawk, Decatur, Emmet: Armstrong; Fayette: Fayette, Kossuth: Wesley; Muscatine: Moscow; Poweshiek: Grinnell; Scott: Davenport; Storey: Ames; Van Buren: Bentonsport. KANSAS. Anderson, Bourbon, Brown, Clay, Dickinson, Douglas, Franklin, Geary, Gove, Greenwood, Harvey, Jackson, Linn, Lyon, Marshall, Miami, Mitchell, Montgomery, Morris, Osage, Ottawa, Pottowatomie, Riley, Shawnee, Wabaunsee, Washington, Wyandotte. KENTUCKY. Christian: Hopkinsville; Edmonson: Mammoth Cave; McCracken: Paducah; Nelson, Robertson: Blue Lick. ?LOUISIANA. St. Landry: Darby Plains. MAINE. Piscataquis: Dover; York: North Berwick. MARYLAND. Allegany: Cumberland; Montgomery: Capitol View. MASSACHUSETTS. Dukes: West Tisbury. MICHIGAN. Ingham: East Lansing. MINNESOTA. Hennepin: Minneapolis, Fort Snelling; Kandiyohi: Willmer; Mille Lacs: Princeton; Nicollet: Swan Lake; Stearns: St. Cloud; Wabasha: Lake City; Waseco: Janesville; Winona. MISSOURI. Atchison, Boone, Cass, Cole, Dent, Greene, Howell, Iron, Jackson, Jasper, Jefferson, Johnson, Lafayette, Lincoln, Linn, Macon, Madison, Marion, McDonald, Mercer, Phelps, Polk, Rolls, Schuyler, Shannon, St. Charles, St. Francis, St. Louis, Washington, Webster, Wright. NEBRASKA. Antelope: Neligh; Brown: Long Pine; Cherry: Swan Lake; Dakota: Emerson; Dodge: Fremont; Gage: Beatrice; Hamilton: Aurora; Lancaster: Lincoln; Nuckolls, Platte: Columbus; Saunders: Ashland; Stanton: Stanton. NEW JERSEY. Middlesex: New Brunswick; Salem: Riddleton, *Mackenzie* 7793; Somerset: Roundbrook, Chimney Rock, *Pennell* 7377. NEW YORK. Essex: Elizabethtown; Rensselaer: Brunswick; Washington: Hudson Falls. NORTH DAKOTA. Cass: Fargo; Ransom: McLeod. OHIO. Adams: Peebles; Champaign: Urbana; Logan: Lewiston, *Leonard* 17359; Miami: Miami; Wayne: Shreve. OKLAHOMA. Craig: Blue Jacket; Rogers: Catoosa, *Bush* 1253. PENNSYLVANIA. Allegheny: Perrymont; Butler: Plains Church; Chester: Nottingham Barrens, Phoenixville, Kern Hill, West Chester, *Pennell* 1549; *Pennell and Long* 7521; Delaware, Franklin: Mercersburg; Lancaster: Dillerville, Pleasant Grove; Montgomery: Red Hill, Pottstown. SOUTH DAKOTA. Brookings: Brookings; Deuel: Gary; Minnehaha: Skink Creek; Roberts: White Rock; Stanley: Fort Pierre. TENNESSEE. Anderson: Andersonville; Davidson: Nashville; Knox: Knoxville, *Ruth* 517, 526, 543, 3356; Marion: Whitwell. ?TEXAS. Austin: San Felipe. VIRGINIA. Augusta: Staunton; Giles: Kerns; Montgomery: Blacksburg; Prince William: Bull Run Mountains; Rockbridge: Natural Bridge; Shenandoah: Valcour, *Pennell* 12120. WEST VIRGINIA. Grant: North Nile Creek; Hampshire: Hanging Rock; Hardy; Wardensville; Mineral: Burlington; Fort Ashby, Morgan: Shady Grove Park; Summers: Hinton; Wetzel: Smithfield; Wirt: Palestine. WISCONSIN. Buffalo, Burnett: *Fassett* 15294; Columbia, Dane, Dunn, Grant, Green, Iowa, Jackson, Juneau, Kenosha, La Crosse, Milwaukee, Monroe, Polk, Racine, Richland, Rock, Sauk: *Fassett* 2690; Trempealeau, Walworth, Winnebago.

6. S. australis Epl., Am. Jour. Bot. 26: 21, 1939.

S. parvula var. *australis* Fassett, Rhodora 39: 378, 1937; type collected by Fassett (no. 18063) on sandstone ledges near White River, Goshen, Arkansas (Univ. Wis.).

A small perennial herb creeping by moniliform rhizomes, its stems erect, usually branching at the base, generally 10–30 cm. tall, *sparingly clothed along the angles with appressed-ascendent hairs and especially with longer spreading capitate glands,* rarely eglandular; blades of the median leaves sessile, ovate and entire, rarely deltoid-ovate, and sparingly dentate, prevailingly 7–10 mm. broad, 10–15 mm. long, those of the lowermost subrotund, usually 7–12 mm. in diameter and borne on petioles 5–15 mm. long, all sprinkled on both surfaces with long capitate glandular hairs, rarely glabrate; *the veins prominent and tending to branch and anastomose along the margins;* flowers disposed above the middle of the plant on pedicels which are ascendent-pubescent, but hardly appressed; lower lip of the calyx 2.5–3 mm. long at flowering, 4–5 mm. long at maturity, the squama 3.5–4.5 mm. tall, sprinkled with capitate glands, concave; galea and tube *7–10 mm.* long, the lower lip hirtellous in two lines, the lower filaments seated near the middle of the tube; nutlets brown, covered with peglike processes, usually banded.

In occasional specimens the spreading glandular hairs are largely or wholly lacking, the stems bearing upwardly appressed hairs only, chiefly along the angles. Such plants occur mostly in eastern Texas adjacent to Louisiana. They have more of the aspect of *S. parvula.* The appressed hairs may sometimes be suppressed, the stems then being clothed only by the spreading glandular hairs.

Distribution (see map 6).—ALABAMA. Calhoun: Oxford; Sumter: Emelle; Tuscaloosa: Tuscaloosa. ARKANSAS. Benton, Hempstead: Fulton, *Bush* 1435, 2342; Independence: Batesville, *E. J. Palmer* 29762; Izard: Guion, *Pennell* 10688; Poinsett: Wiener Valley; Polk: Mena; Pulaski: Little Rock; Washington: Goshen, *Fassett* 18063; White: Judsonia. CONNECTICUT. New Haven: East Haven. DISTRICT OF COLUMBIA. FLORIDA. Gadsden: River Junction, *Mackenzie* 3451. GEORGIA. Baldwin: Milledgeville; Richmond: Augusta. ILLINOIS. Champaign: Urbana; Hancock: Warsaw; Jefferson: Woodlawn, *Eggert* in 1898; Madison: Falling Spring, *Steyermark* 280; Perry: Duquoin; Randolph: Red Bud. INDIANA. Dubois: Holland; Floyd: New Albany, *Deam* 13243; Martin: Shoals, *Deam* 12865; Perry: Cannelton; Posey: Mount Vernon; Spencer: Grass; Warrick: Bonneville. KANSAS. Cherokee, Cloud, Cowley, Crawford, Douglas, Franklin, Geary, Labette, Miami, Riley, Saline, Sedgwick, Shawnee. KENTUCKY. Nelson: New Hope. LOUISIANA. Acadia: Crawley, *Pennell* 10187; Caddo: Shreveport; East Baton Rouge: Baton Rouge; Natchitoches: Natchitoches, *Palmer* 7217; St. Landry. MISSISSIPPI. Hinds: Jackson; La Fayette: Oxford; Oktibbeha: A. and M. College. MISSOURI. Boone, Christian: *Pennell* 11638; Cooper: *Bush* 14756; De Kalb: *Palmer and Steyermark* 41386; Dunklin, Greene, Iron, Jackson: *Mackenzie* 13154; *Bush* 698; Jasper: *Bush* 1587; Maries, Montgomery, Oregon, Ozark: *E. J. Palmer* 34800; Saline, Shannon: *Bush* 59, 316; St. Charles, Wright: *Lansing* 2978. NEW YORK. Albany: New Albany; Queens: Pryor Creek, Long Island. NORTH CAROLINA. Stanley: Falls of Yadkin River. OKLAHOMA. Bryan: Durant; Cleveland: Norman, *Demaree* 12781; Creek: Sapulpa; Johnston: Tishomingo; Le Flore: Pine Valley; Murray: Arbuckle Mountains; Oklahoma: Bethany. SOUTH CAROLINA. Saluda: Saluda. TENNESSEE. Chester: Henderson; Davidson: Nashville, *Eggleston* 4440; Decatur, Fayette: Oakland; Houston: Erin; Rutherford: La Verne; Shelby: Memphis. TEXAS. Angelina: *Parks and Cory* 8035; Brazoria, Burleson, Chambers, Cherokee, Dallas, Erath, Fannin, Galveston, Grayson, Gregg, Harris, Harrison, Houston, Jackson, Jefferson, Limestone, Montgomery, Navarro: *Reverchon* 3909; Orange, San Augustine, Smith, Travis, Upshur, Van Zandt, Walker, Washington. WEST VIRGINIA. Cabell: Huntington; Greenbrier: Lewisburg.

7. **S. parvula** Michx., Fl. Bor. Am. 2: 11, 1803; the type sheet bears two specimens, one collected in Illinois and one near Montreal (Paris); they are similar to each other and to the type of the following.

S. parvula var. *mollis* Gray, Syn. Fl. 2: 380, 1878; type collected by Patterson at Oquawka, Illinois (Gray Herb.).

S. campestris Britton, Mem. Torrey Bot. Club 5: 283, 1894, based upon the preceding.

A small herb, spreading by moniliform rhizomes, its stems usually erect, branching at the base, 10–30 cm. tall, *covered evenly and densely with subretrorse or spreading hairs and with longer capitate glandular ones,* frequently bearing only the glandular hairs in the lower parts; median leaf blades sessile, deltoid-ovate, rarely ovate, usually irregularly subdentate, for the most part *8–19 mm. long, 4–12 mm. broad,* the lowermost subrotund, usually 7–12 mm. in diameter, borne on petioles 5–15 mm. long, the upper surfaces of all hirsute with capitate glands, *the lower clothed like the stems, also more or less sprinkled with sessile golden glands;* flowers mostly above the middle of the plant, borne on *retrorse*-hirtellous pedicels; lower calyx lip 2.5–3 mm. long at anthesis, 4–5 mm. long at maturity, the squama 3–3.5 mm. tall, concave, clothed like the stems; galea and tube 7–10 mm. long, the lower lip hirtellous in two lines, the lower filaments seated near the middle of the tube; nutlets brown or black, covered with peglike processes, banded.

Distribution (see map 6).—ONTARIO. Bruce Peninsula, Great Clocke Island: *Fernald and Pease* 3497, 3498, 3499; Ottawa: *Macoun* 5851; Pelee Island, Point Albins, Port Credit, Port Hope, Port Maitland, Snake Island: *Bicknell* 7634. QUEBEC. Aylmer, Deschenes, Grosse Island: *Fr. Victorin* 16152; Hull: *Fr. Victorin* 16153; Ile Sainte Marguerite: *Fr. Victorin* 25935; Longueill, Montreal.

ALABAMA. Madison: Huntsville. ARKANSAS. Baxter: Cotter, *E. J. Palmer* 5956. *?*GEORGIA. Floyd: Rome. ILLINOIS. Champaign, Cook, Du Page, Hancock, Henderson: *H. Patterson* in 1872, 1873, 1874, 1877; Jackson, Jersey, Kankakee, La Salle, Ogle, Peoria, Rock Island, Scott: *Eggert* in 1875; St. Clair, Will: *Umbach* 5672; Winnebago. INDIANA. Allen, Cass, Crawford: *Deam* 8455; Elkhart, Franklin, Porter, White. IOWA. Johnson: Iowa City; Scott: Buffalo. KANSAS. Labette: Edna, *Rydberg and Imler* 378; Miami, Wilson: Roper. KENTUCKY. Warren: Bowling Green. MAINE. Fulton. MICHIGAN. Berrien: Niles; Ionia: Ionia. MISSISSIPPI. De Soto: Horn Lake; Holmes: Tchula. MISSOURI. Atchison, Barry: *E. J. Palmer* 39468; Boone, Franklin, Howell, Iron: *Greenman* 3862; Jefferson: *Greenman* 4239; Madison, Marion, Ozark: *E. J. Palmer* 34746, 34810; Putnam, Reynolds, Sainte Genevieve: *Greenman* 4569; St. Francis, St. Louis, Stone: *Bush* 15676; Taney: *Bush* 4471; Washington, Wright: *Bush* 1151. NEW YORK. Erie: Buffalo; Jefferson: Dexter. OHIO. Miami: Miami; Ottawa: Marblehead. PENNSYLVANIA. Chester: Nottingham; Lancaster: Mountville. TENNESSEE. Cheatham: Kingston Springs; Davidson: Nashville; Putnam: Cookeville; Rutherford: La Verne; Wilson: Lebanon. TEXAS. Dallas: Dallas; Polk: Livingston; Tarrant: Handley. VERMONT. Addison: Ferrisburg; Chittenden: Burlington, Charlotte; Grand Isle: Providence Island. VIRGINIA. Henrico: Richmond. WISCONSIN. Pierce: Prescott, Rock: Beloit.

8. S. tuberosa Benth., Lab. Gen. et Sp. 441, 1834; type collected in California by Douglas, probably near Monterey (Kew).

A perennial herb creeping with tuberiferous rhizomes and sometimes forming mats; stems 5–20 cm. tall, usually branched at the base and generally viscid with rather long spreading hairs, rarely subglabrous; leaf blades ovate, mostly 1–2 cm. long, coarsely dentate, rarely subentire, viscid-villous with long hairs on both surfaces, the lower borne on petioles .5–1.5 cm. long, those of the median and upper leaves gradually diminished; flowers solitary in the axils, produced nearly to the base of the plant, borne on pedicels 2–3 mm. long; flowering calyces pilose, the lower lip 4–6.5 mm. long, 6.5–7.5 mm. long at maturity, the squama then 3.5 mm. tall, plane, not usually impressed; galea and tube of the blue corollas 12–21 mm. long; lower stamens seated near the middle of the tube; nutlets black, irregularly and coarsely toothed.

S. tuberosa is differentiated into two subspecies, which are apparently indistinguishable in vegetative habit but differ in floral structure. The first occurs in the foothills of the Sierra Nevada and Cascades from Mariposa County, California, to Grants Pass, Oregon, and in the coast ranges as far south as Marin County, California. In content it corresponds largely to *S. tuberosa* var. *similis* Jepson, which was based chiefly upon the more pilose calyx. The second occurs primarily in coastal southern California from Santa Barbara to Santo Tomas in Lower California. It also occurs sporadically as far north as Alameda and Santa Clara counties, California. In the vicinity of San Francisco Bay and southward to Lompoc the two subspecies appear to merge, the intermediates being more abundant than the subspecies themselves. These intermediates lean more nearly towards *S. tuberosa* subsp. *similis*. A form with the corolla glabrous, both on the palate and within the tube, has been recorded from four widely separated localities throughout the range. Both subspecies flower in April and May. The following key was prepared solely from boiled herbarium specimens, and although the absolute measurements might be changed by a study of living populations, the relative difference in proportion is certain:

Palate pilose, the tube glabrous within below the middle, the lower lip broader than long, 3.5–5.5 mm. long, averaging about 4.5 mm., 5–8 mm. broad, averaging about 6.5 mm.; tube and galea 15–20 mm. long, averaging about 18 mm.; tube below point of insertion of lower stamens *6–10 mm.* long, *averaging about 8 mm.* long; lower stamens 8–11 mm. long, averaging 9.5 mm. long, therefore usually *exceeding lower part of tube;* distributed predominantly between 1000–2000 feet.................. *8a.* **S. tuberosa** subsp. **similis**

Palate glabrous, tube hairy within below middle, even annulate, lower lip about as broad as long, 4–6 mm. long, averaging about 5 mm., 4.5–7.5 mm. broad, averaging about 5 mm.; galea and tube 17–21 mm. long, averaging about 19 mm.; tube below the place of attachment of stamens *10–12 mm. long,* averaging about 10.5 mm.; lower stamens *7–10* mm. long, averaging about 9 mm. long, therefore *shorter than lower part of tube;* distributed predominantly below 1000 feet...................... *8b.* **S. tuberosa** subsp. **australis**

8a. **S. tuberosa** subsp. **similis** Epl., Madrono 5: 54, 1939.

S. tuberosa var. *similis* Jeps., Fl. W. Middle Calif. 454, 1901; type collected near Calistoga, Napa County, California (W. L. Jepson herb.).

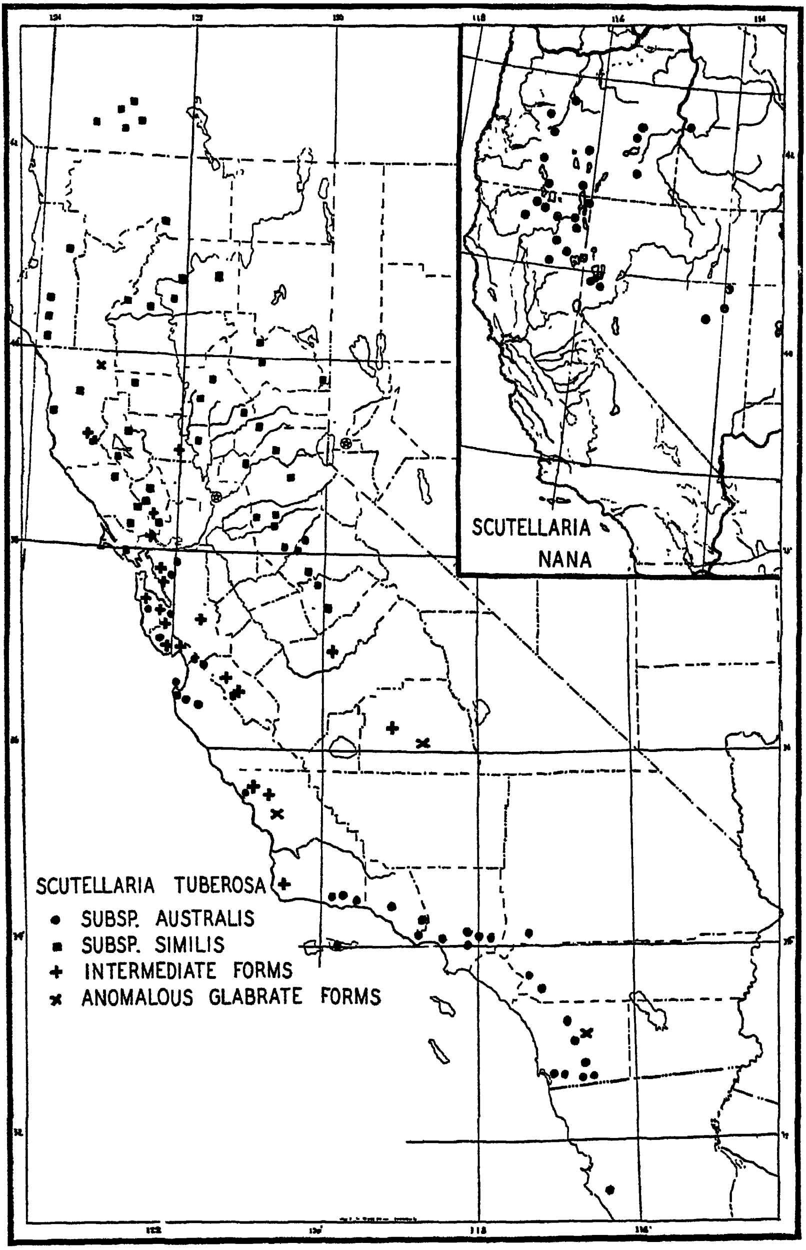
Distribution (see map 7).—CALIFORNIA. Alameda: Livermore; Amador: Ione *Yates* 5150; Jackson, Jones Butte, New York Falls; Butte: Big Chico Creek *Heller* 1834; Little Chico Creek, Clear Creek P.O., Durham; Calaveras: Angels Camp, Avery *Eggleston* 9139; Mokelumne Hill; Contra Costa: Mount Diablo *Eastwood* 4511; Eldorado: Pacific House; Glenn: Alder Spring Road *Applegate* 1625; Humboldt: Buck Mountain, Garberville, Hoopa, Phillipsville, Van Duzen Valley *Tracy* 2717; Willow Creek *Tracy* 6005; Lake: Bartlett Springs *Abrams* 12386; Bendmore Valley *Yates* 4035; Burns Valley, Kelseyville, Mount Hannah, Mount Sanhedrin, Scott Valley *Tracy* 1686; Waldon Valley; Lassen, Marin: Mount Tamalpais; Mariposa: Kinsley, Mariposa; Mendocino: *Bolander* 3929; Albion River, Idol House, Longvale *Tracy* 6221; Ukiah; Napa: Napa, Niebaum's Dam, Pope Valley, St. Helena; Nevada: Moores Flat, Nevada City *Eastwood* 519; Placer: Auburn, Forest Hill *Bolander* 4576; Plumas: Indian Valley; San Benito: The Pinnacles; Santa Clara: Smith Creek at foot of Mount Hamilton; Shasta: Burney, Cow Creek Canyon, Idalpom, Olinda; Siskiyou: Sisson *Applegate* 947; Sonoma: Geysers *Bolander* 3963; Glen Ellen, Petaluma; Sutter: Marysville Buttes; Trinity: Mount Bally; Tuolumne: Columbia, Groveland, Indian Creek; Yuba: Dobbins; OREGON. Jackson: Central Point, Evans Creek, Wimer; Josephine: Galice (Alameda Mine), Grants Pass, Kirby, Williams Creek.

8b. **S. tuberosa** subsp. **australis** Epl., Madrono 5: 54, 1939; type is the specific type.

S. pilosiuscula Nutt. ex Benth., DC. Prodr. 12: 429, 1848 (nomen nudum).

Distribution.—BAJA CALIFORNIA. Santo Tomas, Vallecito.

CALIFORNIA. Alameda: Berkeley, Lake Chabot, Lake Temescal, Mills College, Oakland *Bolander* 2507, 6318; Piedmont, west Berkeley, Woolsey Canyon; Los Angeles: Boney Ridge, Claremont *Baker* 4756; Ganeska Park *Muns and Harwood* 3323, Glendora, Griffith Park, Mandeville Canyon *Clokey and Templeton* 4445; Pomona, San Dimas, San Gabriel, San Gabriel Canyon, Santa Monica Forestry Station *Barber* 46; Santa Susanna Pass, Sepulveda



Map 7. Distribution of *S. tuberosa* and *S. nana.*

Canyon *Abrams* 355, 1303; Verdugo Hills *Abrams* 1409; Westwood; Monterey: Carmel, Pacific Grove, Watsonville; Riverside: Murietta, Santa Ana Mountains; San Benito: Aromas; San Bernardino: Devore, Rialto, San Bernardino; San Diego: Anahuac School *Gander* 3432; Barrett, Dehesa, Descanso, Jamul, Kearney Mesa, La Mesa, Lions Valley, Otay Mountain, Palomar Mountain, Potrero, Ramona, Santa Isabel, Springhill School, Whispering Oaks *Gander* 5286; Witch Creek; San Luis Obispo: Cambria *L. S. Rose* 36074; San

Mateo: San Bruno Hills; Santa Barbara: Carpinteria *Brewer* 266; Cuyama Valley, Gaviota Pass, Santa Barbara, Santa Cruz Island *Fosberg* 7679, 7694; *Abrams and Wiggins* 100; Santa Clara: Alum Rock Park, Mount Hamilton *Brewer* 1037, Stanford University *Abrams* 2355; Santa Cruz: Ben Lomond; Ventura: Ojai.

The intermediate forms with hairy palate and more or less hairy tubes have been found as follows (some, in respect to the hairy calyx, are *S. tuberosa* var. *similis* Jepson):

CALIFORNIA. Alameda: Alameda, Berkeley, Hayward, Mills College, San Antonio Creek, Temescal, Woolsey Canyon *Constance* 146; Colusa: College City; Contra Costa: Moraga Ridge, Mount Diablo; Los Angeles: uncertain locality; Madera: 16 miles east of Madera; Mendocino: Ukiah *Bolander* 3929; Monterey: Carmel River, Pacific Grove *Heller* 6649; Napa: Howell Mountain *Tracy* 1578; Napa; San Benito: Paicines, San Juan Rocks; San Joaquin: Live Oaks; San Luis Obispo: Asuncion, Price Canyon, Templeton; San Mateo: Belmont *L. S. Rose* 35140; Crystal Springs Lake, Jasper Ridge; Santa Barbara: Refugio Pass, Lompoc; Santa Clara: Los Gatos *Heller* 7288; Mount Hamilton *Heller* 8521; Santa Clara *Abrams* 2355; Stanford University *Applegate* 439; *Elmer* 2351; Santa Cruz: Loma Prieta, Santa Cruz, Scott Valley to Felton, Swanton; Tulare: Bear Creek, Milo.

The form with a glabrous corolla has been found as follows:

CALIFORNIA. Mendocino: Round Valley; San Diego: Santa Isabel; San Luis Obispo: San Luis Obispo; Tulare: North Tule River.

The above data have been gathered largely from herbarium material, which, while ample, is still inadequate for more than an approximate analysis. The data available, however, show that detailed analysis of living populations will be well repaid. Although widespread and locally abundant, *S. tuberosa* is nevertheless inconspicuous and may be detected only at a short distance. Furthermore it is ephemeral, the aerial portions withering and disappearing after fruiting, so that sometimes all trace of a large colony will be gone by July.

9. **S. stachyoides** Epl., Lilloa 4: 231, 1939; type collected by F. W. Pennell (no. 19590) on Rio Curahui in the Cerro Saguarivo, San Bernardo, Sonora (U. S. Natl. Herb.).

A perennial herb spreading by short rhizomes, its stems lax, ascendent, as much as 30 cm. tall, clothed on the angles with spreading rigid hairs as much as 1.5 mm. long, the whole plant having much the aspect of *Stachys;* leaf blades ovate, the median ones 12–15 mm. long, ovate, obtuse at the apex, rounded-truncate at the base, their margins rather convex, crenate, both surfaces pilose with rather long hairs; petioles 1–2 mm. long; flowers disposed in the axils of the upper somewhat diminished leaves; flowering calyces 4 mm. long, hispid with spreading stiffish hairs, not seen at maturity; corolla blue-violet, mottled, the galea and tube 15 mm. long, the lower lip 6.5 mm. long; lower stamens seated 8 mm. above the base of the tube; nutlets not seen. The lower lip is unusually long for the genus, in this respect also simulating *Stachys.*

Distribution (see map 4).—Known only from the type specimen.

10. **S. nana** Gray, Proc. Am. Acad. 11: 100, 1876; type collected in Winnemuca Valley near Pyramid Lake, Nevada, by Lemmon (Gray Herb.).

?*S. Footeana* Mulford, Bot. Gaz. 19: 118, 1894, based upon specimens collected in Black Canyon, Idaho, by Mulford; authentic material in Gray Herb. and in herb. of the Mo. Bot. Gard.

A small herb 5–15 cm. tall, creeping by rhizomes which sometimes form slender tubers; stems branching at the base, slender, tufted, cinereous with *short, recurved hairs*; leaf blades quite entire, for the most part oblong-elliptical, 1–1.5 cm. long, 3–6 mm. broad, obtuse at both ends, frequently ovate or oval, even subrotund and as much as 12 mm. in diameter, borne on petioles 1–5 mm. long, both surfaces equally ashy with small curved retrorse hairs; flowers axillary, produced nearly to the base of the plant; flowering calyces 3.5–5 mm. long, cinereous with *short, recurved hairs,* lower lip 5.5–6 mm. long at maturity, upper lip 3.5 mm.

tall, squama concave; corolla tube usually yellowish (rarely blue), glabrous within and pilose only on the palate, galea usually purplish, both together 16–20 mm. long, usually about 17.5 mm., lower lip appressed to the laterals; lower stamens attached near middle of tube; nutlets black, strongly verrucose, and somewhat angled but hardly banded.

This species may be readily segregated from any other related entity, such as *S. antirrhinoides,* by the retrorse and eglandular pubescence (one glandular exception is known). The proportions of the corolla, particularly of the lower lip, and the relation of the stamens to it are also distinctive. The color of the corolla is usually yellowish, being reported as "dull" or "greenish" yellow, although the upper lip may be tinged with purple. The forms of eastern Nevada which have been included here bear wholly blue corollas, similar in appearance, when dried, to those of *S. antirrhinoides,* with which they were confused by Leonard. The nature of the pubescence, distinctive among western species, the conformation of the corolla and leaf habit, all suggest, instead, a relationship with *S. nana.* Future study may determine whether this form is simply a color variant, or is more deeply segregated.

S. Footeana of Idaho, although known only from a single collection, also seems conspecific with *S. nana.* The corolla was described as yellow, becoming orange on the lobes. There is variation in habit, but available material is insufficient to determine whether it has geographic significance.

In California and Oregon the species occurs either with yellow pine, or yellow pine and juniper, lodgepole pine, or *Artemisia tridentata,* mostly above 4000 feet. It flowers in June, July, and August. A blue-flowered specimen collected by Keck was found in the juniper-piñon climax (Nye County, Nevada). Jones collected an anomalous glandular form in Lassen County near Amedee.

Distribution (see map 7).—California. Lassen: Lassen National Forest, Pine Creek *Baker and Nutting* in 1894; Susanville to Horse Lake *J. T. Howell* 11879; Modoc: Alturas *Applegate* 890; Bieber Range, 4500 feet, Duncan Horse Camp, Hackamore *J. T. Howell* 12374; Joseph Creek, Mount Bidwell, 6000 feet, South Fork Pitt River, Warner Range, 5000–6500 feet; Plumas: Chester, 5000 feet, Lassen Buttes, 6000 feet *Brown* 613; Shasta: Burney Spring, Lava Beds, West Prospect Park; Siskiyou: Bray, Caldwell Butte *Applegate* 9365; Edgewood *Palmer* 2602; Igerma *Heller* 8086; Lava Beds National Monument *Thompson* 13171; Weed. Idaho. Gem: Black Canyon. Nevada (cyaniflorae). Nye: Currant (flaviflorae); Washoe: pass between Soda Valley and Warm Springs near Pyramid Lake (type locality) *Kennedy* 1028; White Pine: Ely *Hitchcock* 1286 (blue-flowered); Shellbourne. Oregon. Crook: Farewell Bend *Leiberg* 472; Hay Creek *Leiberg* 209; Laidlaw, Lapine *Peck* 9613; Deschutes: Bend *Applegate* 4841, 4851; Paulina Lake; Harney: Drewsey *Leiberg* 2343; Harney Valley *Howell* in 1885; Riley; Klamath: Crater Lake, Klamath Falls *Peck* 9448; Lost River; Lake: Fossil Lake, Fremont Valley, Goose Lake Valley, Hart Mountain, Lakeview, Pine Lake; Malheur: Malheur to Barren Valley *Cusick* 1234; Steins Mountains, Huffman's, *Cusick* 1980.

11. S. Bolanderi Gray, Proc. Am. Acad. 7: 387, 1868; type collected by Bolander (no. 5006) near Wawona, Mariposa County, California (Gray Herb.).

A perennial herb generally 20–40 cm. tall, spreading chiefly in the lower nodes or simple, *villous with spreading but not straight hairs half the diameter of the stem or longer,* often viscid; leaves generally crowded, the blades of the lowermost 1–2 cm. long, deltoid-ovate, borne on slender petioles 5–10 mm. long, the median and uppermost subsessile, usually equaling or surpassing the internodes, gradually diminished above and ovate-oblong, 2.6

cm. long, 1–2.5 cm. broad, rounded or obtuse at the apex, subtruncate at the base, all save the uppermost coarsely crenate-serrate and sparingly villous; flowers solitary, few; flowering calyces 4.5 mm. long, sparingly villous with spreading more or less glandular hairs, the lower lip 5–6 mm. long at maturity, the squama about 3 mm. tall, concave; corolla *white*, clothed with spreading glandular hairs, the combined tube and galea 12–18 mm. long, the palate strongly pilose, violet, the tube somewhat pilose within but glabrous below the middle, lower lip appressed to the laterals; lower stamens attached *somewhat below the middle of the tube*, the free portion of the filaments 7–11.5 mm. long, the portion of the tube below their attachment 4.5–7 mm. long; nutlets smoky, verrucose, banded.

Although this species ranges widely in California it is highly localized and not frequently collected. It occurs in the valley woodland and yellow pine–white fir, or yellow pine–Douglas fir, associations, mostly between 1000 and 4000 feet. The forms of the Sierra Nevada differ from those of southern California in the size and coloring of the corolla, but apparently not in range of vegetative habit. The species flowers chiefly in July and August.

Confined as it is largely or wholly to gravelly or sandy stream bottoms or wet meadows, this species responds readily to shade or to full sun. The shade forms are much more strict, with thicker, smaller, and more erect leaves.

See note (p. 44, this paper) under section *Mixtae*.

11*a*. **S. Bolanderi** subsp. **typica** Epl., Madrono 5: 58, 1939.

Corolla tube and galea 16–18 mm. long, the lower pair of filaments 9–11.5 mm. long, seated 6–7 mm. above the base of the tube, the lower lip irregularly blotched with violet.

Distribution (see map 8).—CALIFORNIA. Amador: Jackson *Hansen* 448; Plymouth, Waterman *Braunton* 1217; Calaveras: Angels Camp, Calaveras Grove, Mokelumne Hill; Fresno: Big Sandy Creek, Sequoia Mills, Tollhouse *Hall and Chandler*, in 1900; Kern: Poso Creek Valley; Madera: Coarse Gold, Whiskey Creek; Mariposa: Mariposa, Wawona *Bolander* 5006; Plumas: Indian Valley; Santa Clara: in gravel and under rocks along Uvas Creek near Bradley's Store *Epling;* Tulare: Balch Park, Eshom Valley, Giant Forest, Kaweah River *Culbertson* 4199; Three Rivers; Tuolumne: Indian Creek *Williamson* 167; John Gillam Gulch, near Rawhide *Stinchfield* 44.

11*b*. **S. Bolanderi** subsp. **austromontana** Epl., Madrono 5: 58, 1939; type collected by Gander (no. 2739) along Carrizo Creek near Lake Henshaw, San Diego County, California (Univ. Calif. L. A.).

Corolla tube and galea 12–15 mm. long, the lower pair of filaments 7–10 mm. long, seated 4.5–6 mm. above the base of the tube, the lower lip evenly violet, not at all splotched.

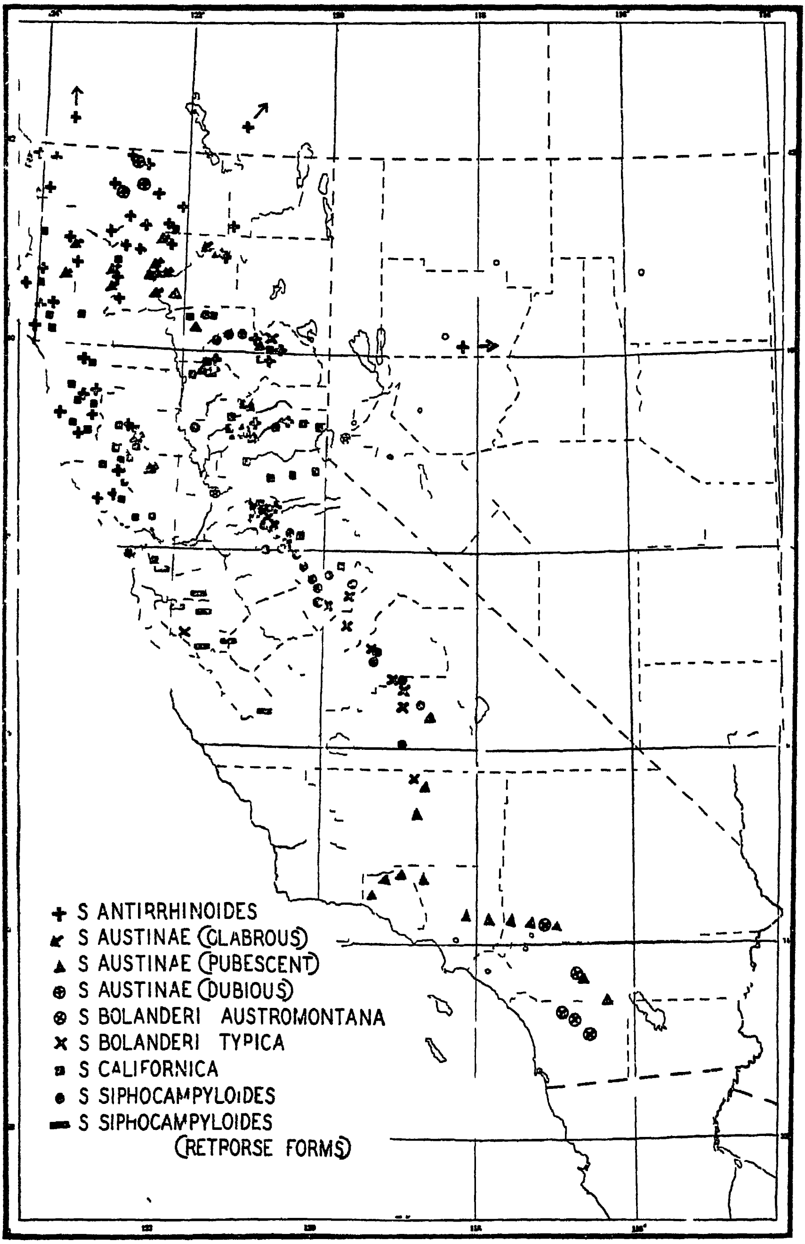
Distribution (see map 8).—CALIFORNIA. Riverside: Idylwild *Hall* 696; *Parish* 474; San Bernardino: Mojave River, Victorville *Parish* 10599; San Diego: Carrizo Creek near Lake Henshaw *Gander* 2739; Deer Park *Chandler* 5468; Green Valley, Japatul Valley, Morena, meadow below Cuyamaca Lake *Gander* 4359; Palomar Mountain *Orcutt* 429; Viejas.

12. **S. californica** Gray, Syn. Fl. 2: 381, 1878.

S. antirrhinoides var. *californica* Gray, Proc. Amer. Acad. 8: 396, 1873, based upon several California collections; I consider Bolander's specimen from Anderson Valley to be the standard.

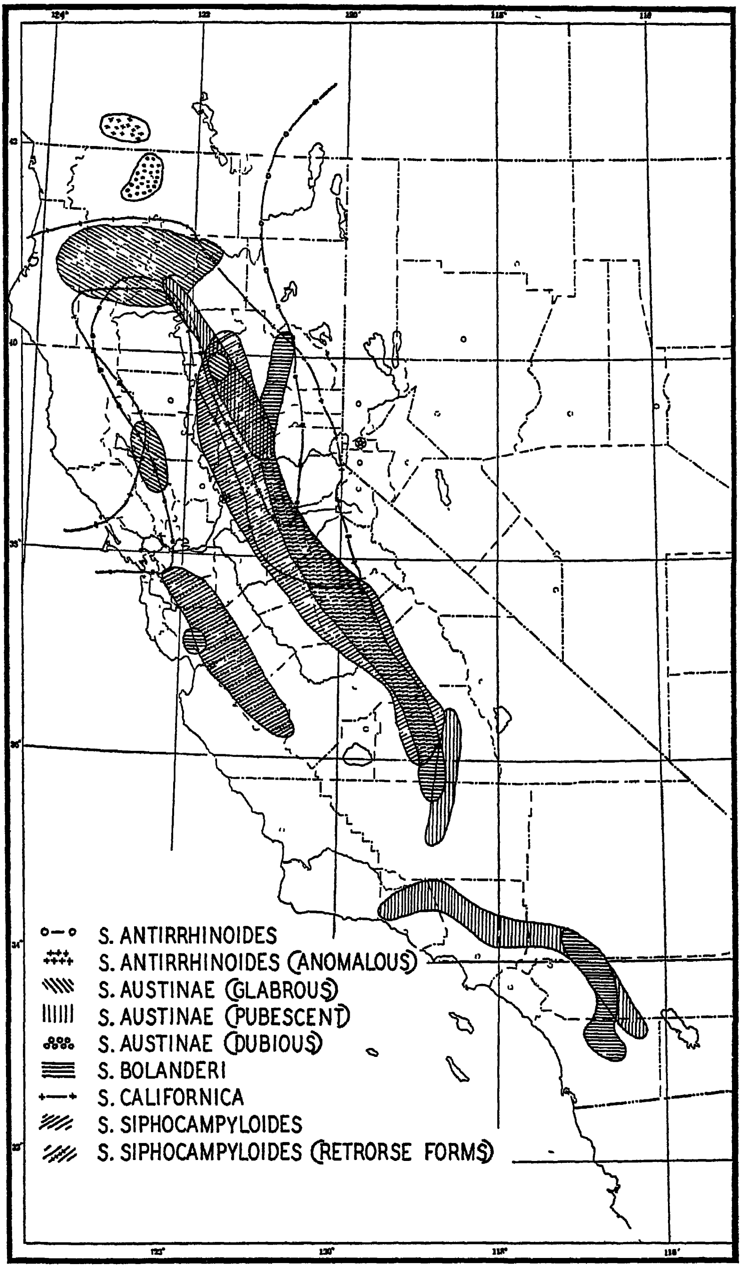
S. Bolanderi var. *californica* Penland, Rhodora 26: 68, 1924.

A perennial herb usually 15–25 cm., rarely 30 cm. tall, spreading by rather thickish rhizomes; stems usually branching at base, puberulent with *upwardly curved hairs* among which small spreading capitate glands frequently occur; blades of lowermost deciduous leaves ovate, 1–1.5 cm. long, crenate-serrate, borne on petioles .5–2 cm. long, those of the upper gradually diminished, lower leaves subcrenate, the upper oblong-elliptic and entire,



Map 8. Distribution in California of *S. Bolanderi, Austinae, californica, siphocampyloides,* and *antirrhinoides.*

subsessile, the median 1.5–3.5 cm. long, 6–12 mm. broad, all pubescent with upwardly curved hairs and usually glandular; flowers axillary, borne mostly above the middle of the plant, pedicels 3 mm. long; lower lip of calyx 4–5 mm. long at flowering, 6 mm. long at maturity, squama then 3.5–4 mm. tall, concave; corolla *whitish,* its galea and tube 14–21 mm. long, lower lip appressed to laterals; lower stamens seated *below middle of tube;* nutlets black, verrucose, obscurely banded.



Map 9. Geographic relationships of five Californian species of *Scutellaria* (from map 8).

In the field this species is readily distinguished, except from rare albinos of other species, by its whitish corolla. Corolla form is the only single difference I have found which may be advanced to distinguish this species from *S. antirrhinoides.* In habit and pubescence *S. californica* is almost identical with that species, and approaches closely its conformation of corolla. The nutlets and the range of variation in both species are too similar to provide a basis of certain differentiation. Measurements of the length and breadth of median leaves (generally the lowermost floral leaves) give almost identical averages. Only in the conformation of the corolla, and particularly in the position of the lower stamens with reference to the base of the corolla tube, do the averages show a significant hiatus. Even here the extremes of *S. antirrhinoides* include those of *S. californica*. The differences show most clearly in the maximum size corollas. *S. californica* is also very similar in corolla conformation to *S. Bolanderi*, but is dissimilar in habit.

The pubescence, when viewed with a lens, does not usually appear glandular although some specimens show a marked sprinkling of slender small capitate glands. Under a compound microscope these glands are usually seen.

The area occupied by *S. californica* is much more restricted than that of *S. antirrhinoides*, for it ranges only along the Sierran foothills from Tuolumne County north to Siskiyou County, and in the north Coast Ranges south to Alameda County, being found from almost sea level in the coastal counties to 6500 feet in the Sierra Nevada. It occurs almost wholly within the southern limits of Douglas fir, both in the Sierran and coastal forests, growing in seepage spots and on banks above streams or along the streams themselves. The species flowers during June and July.

Distribution (see map 8).—CALIFORNIA. Alameda, Amador: *Braunton* 1017, 1047; Butte: *Palmer* 2054; Calaveras, El Dorado, Glenn: *Heller* 11551*a*; Humboldt, Lake: *Tracy* 2297; *Heller* 12379; *Hall* 9525; Marin: *Eastwood* 1530; Mendocino: *Abrams* 7547; Napa: *Tracy* 401; Nevada: *Bacigalupi* 1504; *Hall and Babcock* 4548; *Sonne* 286; *Heller* 7020; *M. E. Jones* 13485; *Williamson* 7020; Placer: *Hall* 8720; Plumas, Shasta: *Bolander* 4833; Siskiyou, Solano, Sonoma: *Jones* in 1931; *Heller* 5743; Tehama, Trinity: *Tracy* 4318, 8802; *Abrams* 6155, 6166; Tuolumne, Yuba.

13. **S. antirrhinoides** Benth., *in* Lindl. Bot. Reg. 18: pl. 1493, 1832; type collected by Scouler along banks of Columbia River near Fort Vancouver (Kew).

S. viarum Heller, Muhlenbergia 1: 32, 1904, based upon specimens collected by Heller (no. 5786) along banks of Russian River near Windsor, Sonoma County, California; the actual type is unknown to me.

S. sanhedrensis Heller, Muhlenbergia 1: 31, 1904, based upon specimens collected by Heller (no. 5894) at Summit Lake on Mount Sanhedrin in Lake County, California; the actual type is unknown to me.

S. nevadensis Eastw., Bull. Torr. Bot. Club 30: 492, 1903; type collected by Beveridge (no. 546) in Little Lakes Canyon, Elko County, Nevada (Calif. Acad. Sci.).

A perennial herb usually 15–25 cm., rarely 30 cm. tall, creeping by rhizomes; stems usually branched at the base, *finely pubescent with upwardly curved hairs*, sometimes sprinkled as well with capitate glands; blades of lower deciduous leaves ovate, 1–2 cm. long, crenate-serrate, borne on petioles .5–1.5 cm. long, blades of upper leaves gradually diminished, ovate-elliptical, entire, the median 6–15 mm. broad, 15–35 mm. long, pubescent on both surfaces with upwardly curved hairs and sometimes glandular; flowers axillary, mostly disposed above the middle of the plant, borne on pedicels 3–4 mm. long; lower lip of calyx 3–4.5 mm. long at flowering, upper lip 5–6 mm. tall, at maturity, concave; corolla violet-blue, tube and galea 12–22 mm. long, lower lip with two lighter blotches on either side of the middle, closely appressed to the laterals, *thus closing the orifice;* lower stamens usually seated *near the middle of the tube;* nutlets black, verrucose, somewhat banded.

S. antirrhinoides is distinguished from *S. californica* predominantly by the position of the stamens within the corolla. It is distinguishable from *S. angustifolia* similarly, and also by the conformation of the corolla lips which close the throat. It differs to a less extent in minutiae of pubescence and habit. The differences of habit are not so great nor so readily perceived, however, and in the absence of flowers these species can readily be confused. Nor do the flowers of either species show enough variation to facilitate identification. In one region plants commonly occur which are not certainly referable to either species. While *S. antirrhinoides* closely approaches *S. Austinae* and *S. angustifolia* it is clearly distinct from their immediate allies, *S. Brittonii* and *S. siphocampyloides*. The differences in foliage habit may be observed by reference to the chart. The flowers of those species, however, do not have the variability of *S. angustifolia,* hence the relative position of the lower stamens is always diagnostic. While the habit and pubescence of *S. antirrhinoides* are fairly stable, its corolla size is variable, although the proportions are fairly constant. Corolla size and certain geographic areas seem somewhat correlated. While the galea and tube are commonly about 16 mm. long, those from Nevada average about 18 mm., and the lowland forms from Humboldt and Del Norte counties average about 20 mm.

In conformation the corollas of *S. antirrhinoides* are intermediate between those of *S. angustifolia* and its immediate allies and those of *S. californica* and *S. Bolanderi.* The extremes lean strongly in both directions.

S. antirrhinoides, the range of which resembles but exceeds that of *S. nana,* has the second widest distribution of this section, and, except for the differences in flower size, is fairly stable throughout this range. In coastal Oregon and in California it occurs chiefly below 2000 feet, but in eastern Oregon, Nevada, and Idaho it ranges to 5000 feet. The species flowers chiefly in June and July. The greatest variation occurs in northwestern California and adjacent southwestern Oregon, an area corresponding in part to Jepson's Tehaman (Man. Fl. Pl. Calif. 12, 1925). The forms in which glandular hairs are abundant, and readily perceptible with a hand lens, seem to be confined largely to this area and usually occur with eglandular forms. Here also are two anomalous forms: in one, the pubescence approximates that of *S. siphocampyloides* as it occurs in the coastal ranges of California; in the other, a plant with all the characteristics of *S. antirrhinoides* is combined with a flower scarcely separable from the smaller-flowered forms of *S. Austinae* in size, in conformation of the corolla, and in the relative position of the lower filaments. A form similar to this intermediate, and difficult of reference to either species, occurs in the vicinity of Ogden, Utah. Yet *S. Austinae* and *S. antirrhinoides* frequently flower side by side in California with no apparent hybridization.

Accordingly, it need not be emphasized that *S. antirrhinoides* is a complex species, further elucidation of which awaits a more detailed study of living populations.

Distribution (see map 8).—CALIFORNIA. Amador, Butte, Del Norte: *Thompson* 4560; Humboldt: *Chandler* 1323; *Tracy* 2914, 3031, 3399; Lake: *Heller* 5894, 13234; *Hall* 9477; Mendocino, Modoc, Nevada, Placer, Plumas: *Heller and Kennedy* 8798, 8843, 37650; *Hall* *and Babcock* 4423; Shasta: *Eastwood* 793; Siskiyou: *Applegate* 3306; *Butler* 1430, 1633, 1690; *Heller* 8020, 12111, 13270; *Copeland* 3530; *Pringle* 200; *Wheeler* 2633; *Brown* 384; Sonoma: *Heller* 5786; *Bolander* 3947; Trinity: *H. M. Hall* 8556; *Tracy* 4314. Idaho. Ada, Adams, Blaine: *Macbride and Payson* 3005; Butte, Custer, Owyhee. Nevada. Elko, Eureka, Humboldt, Lander, Pershing. Oregon. Baker, Benton, Clackamas, Curry, Grant: *Henderson* 5619; Harney: *J. W. Thompson* 12000; *Henderson* 8736; Jackson: *J. W. Thompson* 13145; Josephine, Klamath, Lane, Malheur, Marion, Union, Wasco, Washington. Utah. Uinta Mountains (!).

Following are the localities of perceptibly glandular forms:

California. Humboldt: Buck Mountain, Kneeland Prairie, Shasta Valley, Thrall, Trinity River at Willow Creek; Siskiyou: Goosenest Foothills, Humbug Creek, Mount Shasta; Trinity: Coffee Creek at Union Creek, Weaverville. Oregon. Douglas: Comstock; Josephine: Grants Pass; Klamath: Rock Creek Lodge, west side Upper Klamath Lake.

Following are the localities of an anomalous form with pubescence similar to that of *S. siphocampyloides:*

Oregon. Jackson: High Cascade mountains; Josephine: Rogue River near Grants Pass; Lane: Spencer Butte.

Following are the localities of an anomalous form intermediate with *S. Austinae:*

California. Shasta: near Grisels Mill; Siskiyou: Cherry Creek, Humbug Creek, Klamathon, Scott River Valley, Yreka. Oregon. Grant: Hamilton; Harney: Burns. Utah. Morgan: Peterson Canyon; Weber: Ogden Canyon.

14. S. angustifolia Pursh, Fl. Am. Sept. 412, 1814; type collected by Lewis and Clark along the Clearwater River, near Kamiah, Idaho (Acad. Sci. Phila.).

S. veronicaefolia Rydb., Bull. Torr. Bot. Club 36: 681, 1909; type collected by Sandberg, MacDougal, and Heller (no. 115) along Peter Creek, Nez Perces County, Idaho (N. Y. Bot. Gard.).

A perennial herb usually 15–30 cm. tall, creeping by slender rhizomes; stems usually branched at the base, generally *appressed-hirtellous with ascending hairs,* these less often replaced with spreading capitate glands; blades of the lowermost leaves ovate, subcrenate, 1–2 cm. long, borne on petioles .5–3 cm. long; those of the upper gradually diminished, entire, subsessile, *oblong-ovate* or oblong, appressed-hirtellous with ascending hairs unless capitate-glandular, sometimes, at least the upper surfaces, nearly glabrous; flowers axillary, borne on pedicels which are 5–6 mm. long at maturity; lower lip of calyx 4.5–5.5 mm. long at flowering, 5.5–7 mm. long at maturity, the squama then 4–5 mm. tall, concave; corolla deep violet-blue, its galea and tube 20–32 mm. long, arcuate below the middle, *lower lip not appressed to the laterals* unless at their bases; lower stamens seated somewhat above the middle of the tube; nutlets black, verrucose, sometimes lightly banded.

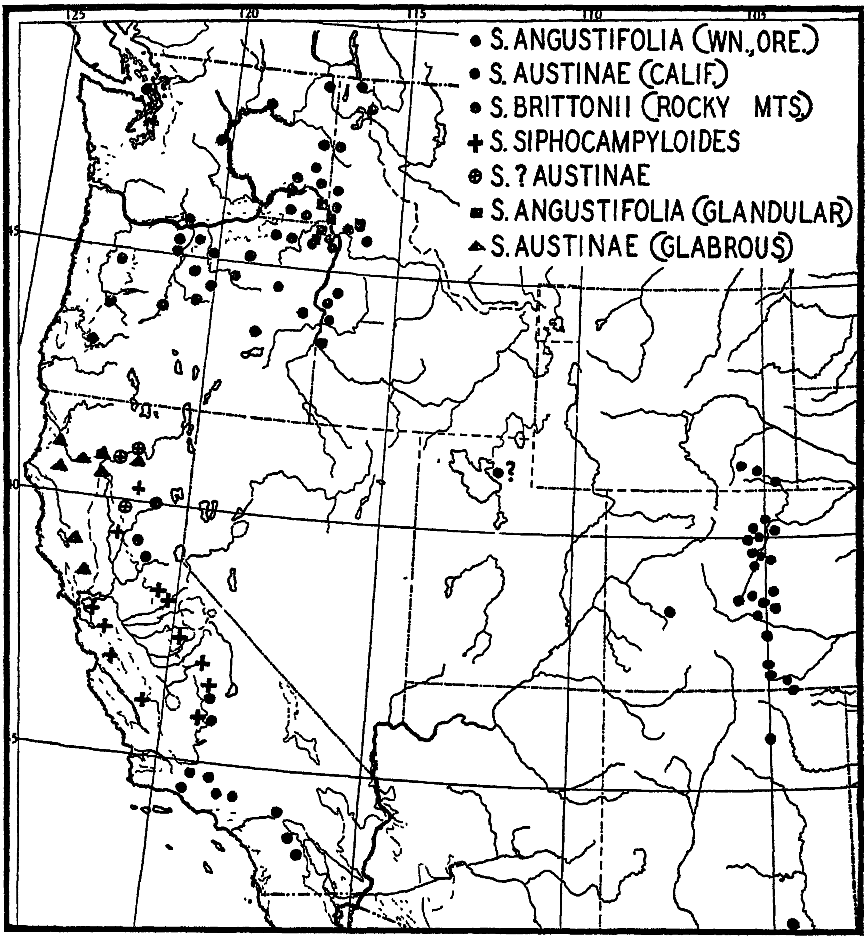
(See discussion p. 9 and following.)

S. angustifolia, in pubescence, shows a marked variation in which the usual eglandular appressed hairs are replaced by spreading capitate glands. This variant apparently occurs in company with the eglandular type, and is restricted to the Snake River drainage area in western Idaho. The species flowers in May, June, and July, and usually occurs below 2500 feet.

Distribution (see map 10).—British Columbia. Idaho. Adams, Boise, Bonner: *Leiberg* 482; Boundary, Canyon: *Macbride* 104; Idaho: *Constance* et al. 1119; Kootenai: *Leiberg* 1548, 8689, 24468; *Sandberg* 4328; Latah: *Abrams* 710; Nez Perce: *Sandberg, MacDougal, and Heller* 115; *Sandberg* 115, 8689; *Heller* 3150, 3154; Payette. Oregon. Baker, Crook, Deschutes, Grant: *Henderson* 5368; Harney, Lane, Malheur, Polk, Sherman: *Peck* 9950; Umatilla, Union, Wallowa: *Sheldon* 8007; *Peck* 18298; *Constance, Rollins and Dillon* 1571; Wasco, Wheeler: *Henderson* 5369. Washington. Asotin, Chelan, Island, Klickitat, Okanogan, Pend Oreille: *Thompson* 9223; Spokane, Stevens, Walla Walla, Whitman: *Piper* 1570, 1571; *Elmer* 181, 900; *Constance* et al. 1053.

The glandular forms occur as follows:

Idaho. Idaho: Kamiah, Snake River (Willow Creek); Nez Perce: Lewiston, Peter Creek. Oregon. Wallowa: Deep Creek (Snake River), Enterprise, Troy. Washington. Whitman: Clarkston, Truax.



Map 10. Distribution of *S. angustifolia, Brittonii, siphocampyloides,* and *Austinae.*

15. **S. Brittonii** Porter, Bull. Torr. Bot. Club 21: 177, 1894; type collected by Coulter in Clear Creek Canyon, Colorado (Acad. Sci. Phila.).

S. virgulata Nels., Bull. Torr. Bot. Club 25: 283, 1898; type collected by Nelson (no. 3218) in Wyoming in the Laramie Hills (Rocky Mtn. Herb.).

S. Brittonii var. *virgulata* Rydb., Fl. Colo. 296, 1906.

A perennial herb generally about 15 cm., rarely 30 cm. tall, spreading by thickish rhizomes; stems usually branched at the base, variously pubescent, nearly glabrous, puberulent with retrorse-appressed hairs or with upcurved curled hairs or with either one or the other of these types associated with spreading capitate glands; blades of the lowermost leaves oval, 8–15 mm. long, entire, borne on petioles 3–5 mm. long, those of the upper sessile, *ovate-elliptical,* entire, gradually diminished upwards, the median *17–35 mm. long, 6–12 mm. broad,* entire, frequently somewhat revolute, both surfaces now nearly glabrous, now pubescent and more or less glandular; flowers axillary, borne mostly above the middle of the plant on pedicels 3–4 mm. long; lower lip of calyx 4.5–6.5 mm. long at flowering, 7–8 mm. long at maturity, the squama then 4–4.5 mm. tall, concave; corolla deep violet-blue, its tube and galea 23–32 mm. long, arcuate below the middle, lower lip glabrous, *not appressed to the laterals* unless at their bases; lower stamens seated somewhat above the middle of the tube; nutlets black, verrucose, banded.

The average median leaves of *S. Brittonii* are nearly proportional to those of *S. angustifolia,* although the average dimensions differ. As a rule the veins of the leaves of the former are more prominent and seven in number. The texture of the leaves is different. Although the flowers of *S. Brittonii* and *S. angustifolia* are nearly identical, the latter, in pubescence and habit, is much more like *S. antirrhinoides* than like *S. Brittonii.* The species flowers in May and June.

The species exhibits two pubescence forms, the first clearly defined and retrorse, the second (*S. virgulata*), while appearing partly retrorse under a compound lens, is nevertheless somewhat curled upward. Both forms may be sprinkled with spreading capitate glands. The two forms are apparently not otherwise distinguishable, and commonly occur together throughout most of the range of the species.

Distribution (see map 10).—COLORADO. Boulder: *Patterson* 296; Clear Creek, Denver: *Coulter* in 1873; Douglas, El Paso: *M. E. Jones* in 1879 and 1878; Fremont: *Brandegee* 413; Garfield: *Osterhout* 2587; Gilpin, Huerfano: *Rydberg and Vreeland* 5671; Jefferson: *Clokey* 3060; Larimer: *Crandall* 416, 1706, 1707; *Baker* 73, 126; Las Animas, Park, Saguache, Teller, Weld: *Osterhout* 2286, 3166, 6174. NEW MEXICO. Colfax, Eddy: *Nelson* 11372; Mora. WYOMING. Albany: *Nelson* 94, 1918, 3147, 3218, 7009; Converse, Laramie, Sublette: *Nelson* 1365.

16. **S. siphocampyloides** Vatke, Bot. Zeitschr. 30: 717, 1872; type collected in California by Bridges (Berlin).

S. angustifolia var. *canescens* Gray, *in* Brewer and Watson Bot. Calif. 1: 603, 1880, based upon three specimens. I consider the specimen collected near Pacheco Pass by Brewer (no. 1285, Gray Herb.), to be the standard; the others were collected by Bolander at the Geysers (no. 3947) and on Mount Bullion (no. 4946).

A perennial herb generally 20–40 cm. tall, spreading by slender rhizomes; stems usually simple, rarely branching at the base, *glandular with spreading capitate glands and pubescent with either ascending or retrorse hairs which are but little curled;* blades of lowermost leaves ovate or oval, subcrenate, 1–2 cm. long, borne on petioles .5–3 cm. long, soon deciduous, those other than the basal prevailingly *oblong-elliptical, generally 2–3 cm. long, .5–1 cm. broad,* subsessile, obtuse, entire, or rarely subserrate, both surfaces softly pubescent with curled hairs and capitate glands; flowers axillary, generally borne above the middle of the plant on pedicels 3–5 mm. long; lower lip of calyx 4.5–5 mm. long at flowering, 5.5–7 mm. long at maturity, the squama then 4–4.5 mm. tall, concave; corolla deep violet-blue, its tube and galea 24–30 mm. long, arcuate below the middle, lower stamens seated somewhat above the middle, *lower lip not appressed to the laterals* unless at their bases; nutlets black, verrucose, obscurely banded.

In addition to being indistinguishable from *S. angustifolia* in flower structure and proportions, *S. siphocampyloides* frequently resembles *S. californica* in habit. This is due to two characteristics found in both: a median leaf that is oblong, and lower leaves that tend to be toothed. The species comprises two well-defined and isolated geographic races. The first, which occurs in the foothills of the Sierra Nevada, is distinguished by the ascendent pubescence, characteristic of most of the group to which this species belongs. The hairs are longer, however—often twice as long as those of *S. angustifolia* or *S. Austinae*—and are more spreading. The capitate glands are seldom absent and are well developed. As a result, the pubescence is much more noticeable, particularly under a lens, than in any other member of this group. The second race, found in the Coast Ranges south of San Francisco Bay, has nearly the same pubescence as the first, but it is clearly retrorse, comparable to that of *S. Brittonii*, and of different texture. As previously pointed out, an anomalous form of *S. antirrhinoides*, with much the same pubescence, is known in southwestern Oregon. A form from Tulare County has reduced pubescence scarcely separable from that of *S. angustifolia*.

Distribution (see maps 8, 10).—CALIFORNIA. Alameda: Cedar Mountain *Elmer* 4434, Hayward, Mocho Creek, Oakland hills; Amador: Ione *Braunton* 1026; Butte: Butte Creek *Eggleston* 7308, Butte Meadows *Heller* 12814, Chico Meadows; Calaveras: Angels Camp, Copperopolis *Tracy* 5605, Harman Peak, Mercers Cave, Milton, Mokelumne Hill, North Fork Calaveras River near San Andreas, Reservoir, Wallace; Fresno: Badger, Big Sandy Creek, Pine Ridge *Hall and Chandler* 242, Rush Creek Mill, Tollhouse, Trimmers Springs; Mariposa: Greeley Hill above Coulterville, Mount Bullion *Bolander* 4946; Placer: Stillwater; Plumas: Butte Creek, Prattville; San Benito: Hernandez; Santa Clara: Coyote Creek *Dudley* 4131, Gilroy, Isabel Creek (Mount Hamilton), Pacheco Pass *Brewer* 1285; Sutter: Marysville Buttes; Tehama: Mineral; Tulare: Dry Creek, Homers Nose (Sequoia National Park), Kaweah River, Middle Tule River *Purpus* 5605, Paradise Ridge; Tuolumne: Harden Ranch, Sonora, Spring Gulch near Bear Creek *Williamson* 24, Taylor Hill.

17. **S. Austinae** Eastw., in Bull. Torr. Bot. Club 30: 493, 1903; type collected by Mrs. Bruce (no. 1835) along Big Chico Creek, Butte County, California (Calif. Acad. Sci.).

S. linearifolia Eastw., loc. cit.; type collected by W. J. Fisher (no. 586) at "San Diego," California (Calif. Acad. Sci.).

A perennial herb generally 10–30 cm. tall, spreading by slender rhizomes; stems usually branched at the base, either *entirely glabrous or puberulent with small ascending curved hairs;* blades of lowermost leaves oval or oblong, on petioles about equal in length, soon deciduous, those of all but the basal *oblong-elliptical or linear,* obtuse, entire, either wholly glabrous or puberulent with small ascending curved hairs, prevailingly *1.5–3 cm. long, 3–6 mm. wide,* subsessile; flowers axillary, disposed above the middle of the plant, borne on pedicels 3–5 mm. long; lower lip of calyx 4.5 mm. long at flowering, 5–6.5 mm. long at maturity, the squama then 3.5–4.5 mm. tall, concave; corolla deep violet-blue, its tube and galea 23–29 mm. long, arcuate below the middle, *lower lip not appressed to the laterals unless at their bases;* lower stamens seated somewhat above the middle of the tube; nutlets black, verrucose, obscurely banded.

This species is most like *S. angustifolia,* differing chiefly in habit. The pubescence is essentially that of *S. angustifolia.* It is not at all glandular or rarely so. The habit of the whole plant may be expressed in the averages of the median leaves (see fig. 3) which, while nearly the same shape as in *S. siphocampyloides,* are significantly narrower. The species exists in three segregated areas each of which is characterized by a form peculiar to it. The plants of the north Coast Ranges are quite glabrous and the proportions of the median leaves are of a definite order. Somewhat puberulent forms are infrequent. In the northern and central Sierran foothills occurs a second form, the typical (nomenclatorially). It is puberulent, with a pubescence much like the eglandular forms of *S. antirrhinoides,* and its median leaves average less in length and in width. In the southern Sierra and especially in the mountains of southern California is a third, smaller form (*S. linearifolia*), with similar pubescence but with even narrower and shorter leaves, which grows in colonies of remarkable uniformity. In flower structure and size the species is not very different from *S. angustifolia.*

The species occurs on dry, usually stony, banks or in gravel, frequently along the dry margins of streams, and is found chiefly in association with the drier aspects of the yellow-pine forest. Its western limit corresponds with that of yellow pine in Humboldt County. Although the type was collected along Chico Creek, presumably under oaks, it seldom ranges into the oak woodland. In the Sierra Nevada and north Coast Ranges it seldom occurs above 2500 feet. In southern California it occurs chiefly from 3500–5000 feet. It flowers chiefly during June and July.

Distribution (see map 10).— CALIFORNIA. Butte: *Heller* 14397; Humboldt, Kern, Lake, Los Angeles: *Dudley and Lamb* 4387; *Abrams and McGregory* 344; *Duncan* 3503; Napa, Nevada: *Hall and Essig* 10178; *Eastwood* 560; Plumas: *Hall and Babcock* 4423; Riverside: *Hall* 334, 1251; San Bernardino: *Munz* 10551; *Parish* 3122, 10919, 10920; *Abrams* 2058, 2778; *Clokey* 5306; *Parry and Lemmon* 336, 337; *Goodman and Hitchcock* 1738; Shasta: *Heller* 7889; *Eastwood* 1440, 11966; *Applegate* 5746; Siskiyou, Tehama, Trinity, Tulare: *Culbertson* 4446; Tuolumne, Ventura: *Dudley and Lamb* 4576; *Munz* 13176; Yuba.

SECTION II. **Antarctica**

Antarctica Epl., Lilloa 4: 232, 1939. The type species is *S. nummulariaefolia* Hook. f. There is apparently no direct alliance with any other American species.

Low herbs, spreading by slender creeping rhizomes, with short spreading pubescence. Leaves subrotund, entire, sessile. Flowers few, solitary in the axils of the upper diminished leaves, the corolla blue or rose color. Both pairs of stamens seated below the middle of the tube, which is annulate. Mature scutellum subconical, not compressed. Achenes obpyriform, black, studded with short pegs except the upper part of the interior surface.

18. **S. nummulariaefolia** Hook. f., Fl. Antarctica 2: 336, 1847; type collected by Darwin in Tierra del Fuego (Kew).

?*Cruzia serpyllacea* Phil., Anal. Univ. Chil. 90: 558, 1895; type collected by Ibar on the Santa Cruz River, southern Patagonia (presumably in the Philippi herbarium at Santiago).

A small caespitose herb, creeping by rhizomes and apparently forming mats, the erect stems 3–15 cm. tall, puberulent with short spreading hairs; leaf blades .5–1.5 cm. long, rotund-obovate, abruptly narrowed at the base, nearly sessile or on petioles as long as 2 mm., entire, both surfaces clothed like the stems; flowers solitary in the upper axils, borne on pedicels 2–3 mm. long; flowering calyces 3–4 mm. long, clothed with short spreading hairs, 5–6 mm. long at maturity, the upper lip then subconical, not impressed; corolla purplish pink, shading to white, the galea and tube 10–11 mm. long, the former about 4.5 m. tall, the tube hairy within and annulate near the attachment of stamens; both pairs of stamens seated below the middle of the tube, about 2.5 mm. above its base; nutlets black, obpyriform, paxillate, nearly 3 mm. long.

Distribution (see map 5).—ARGENTINA. Chubut, Neuquen, Zapala *Hauman;* Lago Musters *Roth;* Choique Vielahne *Roth;* Valley of Laguna Blanca, 71° 15′ E., 45° 12′ S. *Kos-*

lowsky 53; Rio Chubut *Illin;* Santa Cruz, between Lago Buenos Aires Norte and Rio Mayer toward Rio Liesta, 71°–72° 20′ E., 46° 15′ S. *von Platten and Greiner* 107; Lago Argentino *Hanthal;* Isla Pavon *Spegazzini* 1509; in Patagonia andina *Skottsberg* 141; Rio Santa Cruz *Dusen* 5541; San Julian *Darwin;* Meseta *Donat* 216. Tierra del Fuego. San Sebastian *Dusen* 322; East Coast *Darwin;* Viamonte, near Cabo Pena *Mexia* 7931.

Falkland Islands. Fox Bay *Vallentin.*

Chile. Straits of Magellan, Gregory Bay and Laredo Bay *Lee;* Cape Gregory *King;* Pickett Harbor *Cunningham.*

Section III. **Lateriflorae**

Lateriflorae Benth., in Lindl. Bot. Reg. 18. pl. 1493, 1832.

Sect. *Galericularia* subsect. *Lateriflorae* Benth., DC. Prodr. 12:429, 1848.

Sect. *Maschalostachys* Benth., Lab. Gen. et Sp. 443, 1834. The type species is *S. lateriflora.* Except for a presumed connection through hybridization with *S. galericulata* and with *S. ovata,* this sections bears no direct alliance with any other American sections.

Low herbs with slender or filiform perennial rhizomes, the annual stems erect and branching, rarely more than 50 cm. tall. Leaf blades membranous, deltoid-ovate, petiolate. Flowers solitary in the axils of persistent subfoliose bracts and disposed in lateral axillary racemes. Upper lip of calyx roughly pyramidal, that is, not at all compressed, or but slightly so and not impressed. Corolla blue, the tube nearly straight, sparingly pilose within between the bases of the stamens or glabrous. Nutlets buff, verrucose, subcompressed.

19. **S. lateriflora** L., Sp. Pl. 598, 1753; type collected in Virginia by Clayton, formerly in Gronovian herb. (Brit. Mus.).

S. lateriflora var. *albiflora* Farw., Mich. Acad. Sci. Ann. Rep. 19: 249, 1917.

S. l. forma *albiflora* Fern., Rhodora 23: 96, 1921.

S. l. forma *rhodantha* Fern., l. c., 1921.

A perennial herb usually 30–60 cm. tall, spreading by slender rhizomes, the stems slender, quadrate, channelled, branching in the upper axils, the branches ascending, glabrate but rarely entirely glabrous in the lower parts, usually appressed-hirtellous along the angles in the upper parts and sometimes sprinkled with small spreading capitate glands; leaf blades membranous, 3–7 cm. long, 2–3.5 cm. broad, deltoid-ovate, rather acute at the apex, rounded-truncate at the base, their margins crenate-serrate, the upper surface glabrous, the lower appressed-hirtellous along the veins; petioles .5–2 cm. long; flowers solitary in the axils of persistent, subfoliose bracts, disposed in lateral axillary racemes usually 3–8 cm. long, ascending and often numerous; flowering calyces 1.5–2.5 mm. long, membranous, hirtellous with minute ascending hairs, less often sprinkled also with small capitate glands, the lower lip scarcely enlarged at maturity (at most about 3.5 mm. long), the upper about 2.5 mm. tall, the squama not at all impressed; corolla blue, hirtellous with small spreading hairs, the galea and tube 5–7 mm. long, sparingly pilose within between the bases of the stamens, or glabrous; upper stamens seated above the middle of the tube, the lower near or somewhat below the middle, all minutely hirtellous below the middle, the anthers ciliate; nutlets buff, verrucose, subcompressed.

S. lateriflora ranges from latitude 30° to 50°, and farther north in western Canada. It is infrequent south of 35°, and is not recorded from Mexico. It is most abundant in the drainages of the Ohio and St. Lawrence rivers. In one form small capitate glands are sprinkled through the inflorescence and on the calyces in addition to the appressed hairs. This glandular form has been found as far south as Arkansas, Mississippi, and Georgia and as far west as Oklahoma and Minnesota. It seems to center in Pennsylvania, being more frequently collected there than the eglandular form. It is equally abundant in New York, the New England states, and the maritime provinces of Canada. It is less frequent as one proceeds southward and westward. It is infrequent west of the Mississippi River and apparently does not occur west of the plains states, save for one record in Arizona.

Distribution (see map 3).—CANADA. BRITISH COLUMBIA. Chilliwack Valley, Front Lake City, Harrison Lake, New Westminster, Vancouver Island. NEW BRUNSWICK. General. NEWFOUNDLAND. Deer Lake, Rush Pond. NOVA SCOTIA. General. ONTARIO. General in southwestern Ontario. PRINCE EDWARD ISLAND. General. QUEBEC. General in the valley of the Saint Lawrence River.

ALABAMA. Mobile: in swamps of delta of Mobile River. ARIZONA. Beaver Creek, Oak Creek, Yavapai: Aultman, irrigating ditches north of Camp Verde. ARKANSAS. Benton: Decatur; Chicot: in valley land; Craighead: Lake City in wet woods; Crittenden: Menosha; Pulaski: Sandy bottoms, Arkansas River. CALIFORNIA. Inyo: Saline Valley, Inyo Range. COLORADO. Yuma: Wray. CONNECTICUT. General. DELAWARE. Sussex: Laurel, Seaford. DISTRICT OF COLUMBIA. FLORIDA. Duval: Jacksonville; Jackson: swamps along Apalachicola River. GEORGIA. Floyd: Rome; Walker: Lafayette. IDAHO. Benewah: St. Maries, river bottom; Bonner: Granite Station, Priest Lake, Priest River Valley, Upper Priest Lake; Kootenai: Coeur d'Alene, O'Gara, Old Mission Peak. ILLINOIS. Champaign, Clinton, Cook, DePage, Hancock, Johnson, Kankakee, Lake, La Salle, Macon, Madison, McDonough, Peoria, Pike, Richland, Rock Island, Stark, St. Clair, Will. INDIANA. Allen, Blackford, Boone, Brown, Cass, Clark, Clay, De Kalb, Delaware, Elkhart, Franklin, Fulton, Gibson, Grant, Kosciusko, Lake, La Porte, Marion, Marshall, Porter, Starke, Vigo, Wells. IOWA. Benton: Vinton; Black Hawk, Buchanan: Hazeltown; Emmet: Estherville; Fayette, Hardin: Iowa Falls; Johnson: Elmira; Muscatine: Moscow; Poweshiek: Grinnell; Story: Ames; Van Buren: Bentonsport. KANSAS. Brown, Butler, Cherokee, Clay, Cloud, Ellis, Gove, Hamilton, Hodgeman, Johnson, Kingman, Kiowa, Labette, Osage, Pottawatomie, Reno, Riley, Rooks, Saline, Shawnee, Sheridan, Trego, Woodson. KENTUCKY. Bell: Cumberland River; Hart: Bonnieville; Lincoln: Kings Mountain; Lyon: Kuttawa; Warren: Cassaday. LOUISIANA. New Orleans, Ouachita: Sicard; Terrebonne: Prairie Drainage Canal. MAINE. General. MARYLAND. Baltimore, Charles, Garrett, Harford, Prince George, St. Marys, Talbot. MASSACHUSETTS. General. MICHIGAN. Roscommon: Roscommon. MINNESOTA. Beltrami: Lavinia; Chicago: Center City; Clearwater: Itaska Park; Cook: Lake Saganaga; Freeborn: Lake Albert Lea; Goodhue: Zumbrota; Hennepin: Minneapolis; Mille Lacs: Milaca; Norman: Heiberg; Sterns: St. Cloud; Wabasha: Kellogg; Winona: Winona. MISSISSIPPI. Simpson: Saratoga. MISSOURI. Atchison, Bollinger, Boone, Buchanan, Butler, Case, Cooper, Dallas, Dunklin, Garrett, Greene, Howell, Iron, Jackson, Jasper, Jefferson, Johnson, Marion, McDonald, Oregon, Perry, Phelps, Ripley, Ste. Genevieve, St. Francois, St. Louis, Stoddard, Taney. NEBRASKA. Antelope: Neligh; Cass: Ash Grove, Weeping Water; Franklin: Franklin; Holt: Ponca; Hooker: South Fork Dismal River; Howard: St. Paul; Kearney: Minden; Saline: Crete; Stanton: Elkhorn River; Thomas: Halsey. NEW HAMPSHIRE. General. NEW JERSEY. General. NEW MEXICO. Uncertain locality *Wright* 1538. NEW YORK. General. NORTH CAROLINA. Bladen: Kelly; Henderson: Muddy Creek; Iredell: Statesville; Madison: Paint Rock. NORTH DAKOTA. Cass: Fargo; McHenry: Towner; Rolette: Turtle Hills near Dunseith. OHIO. Ashtabula, Cuyahoga, Darke, Erie, Franklin, Hamilton, Holmes, Lake, Licking, Loraine, Pickaway, Portage, Wood. OKLAHOMA. Cherokee, Creek: Sapulpa; Ellis: Lake Ivanhoe; Osage: Pawhuska; Ottawa: Ottawa. OREGON. Clackamas: Oregon City; Columbia: Clatskanie; Lane: Wendling Road; Marion: Brooks, Orville, Salem; Multnomah: Portland; Tillamook, Washington: Forest Grove, Hillsboro. PENNSYLVANIA. Allegheny, Adams, Bedford, Bucks, Center, Cameron, Chester, Columbia, Crawford, Delaware, Elk, Franklin, Greene, Indiana, Kent, Lackawanna, Lancaster, Lebanon, Lehigh, Luzerne, Lycoming, McKean, Monroe, Montgomery, Newport, Northampton, Northumberland, Philadelphia, Pike, Pocono, Schuylkill, Sullivan, Snyder, Tioga, Wayne, Westmoreland. RHODE ISLAND. General. SOUTH CAROLINA. Anderson: Piedmont; Berkeley: Santee Canal. SOUTH DAKOTA. Beadle: Pearl Creek; Brookings: Brookings; Clay: Vermillion; Roberts: Big Stone Lake; Spink: Redfield. TENNESSEE. Blount: Cades Cove; Carroll: Huntingdon, Hollow Rock; Chester: Henderson; Knox, Polk: Hiawassee Valley; Shelby: Memphis; Sumner: Thompson. VERMONT. General. VIRGINIA. Fairfax: at Great Falls, Telegraph Road; Fauquier: the Bull Run Mountains, near Aldie; Giles: Bane; Gloucester: James Store; Hanover: Ashland; James City: Longhill, west of Williamsburg; Montgomery: Blacksburg; Norfolk: Ocean View; Shenandoah: Passage Creek near Powells Fort; Southhampton: Franklin; Warwick: Newport News. WASHINGTON. King: Seattle, Renton; Lewis: Chehalis; Okanogan: Sinlakekin Creek; Pierce: Tacoma; Snohomish: Marysville; Whatcom: McCloud Lake. WEST VIRGINIA. Barbour, Calhoun, Fayette, Grant, Hampshire, Kanawha, Monroe, Pendleton, Pocahontas, Preston, Summers, Tucker, Upshur, Wayne, Webster, Wetzel. WISCONSIN. General.

SECTION IV. **Mixtae**

Low herbs with slender or filiform perennial rhizomes or stolons, the annual stems erect, usually simple below and branching in the inflorescence if at all, infrequently more than 50 cm. tall, but sometimes as much as a meter; a strict stiffish annual in one species. Leaf blades membranous, commonly ovate or deltoid-ovate and more or less cordate, less often narrowly ovate and rounded at the base, commonly borne on well defined petioles, rarely subsessile. Flowers solitary in the axils of persistent leaflike bracts and disposed in racemes which are terminal or sometimes subaxillary, rarely in the axils of the upper diminished leaves. Upper lip of calyx compressed and cupped. Corolla blue or purplish, the tube glabrous within or sparingly hirtellous, pilose in the species, the lip glabrous. Nutlets black, brown or buff, papillate or covered with peglike processes.

The species in this section are unusually diverse and yet show a remarkable continuity of form. It is hard to avoid the suggestion that at least three, *S. saxatilis, S. arguta,* and *S. ovata,* form a polyploid phylad, which has perhaps had its origin in such forms as *S. lateriflora* and *S. ovata* subsp. *mexicana.* At the same time, *S. Churchilliana* strongly suggests a species of hybrid origin in *S. lateriflora* and *S. galericulata,* for it is quite intermediate between these supposed progenitors. Although *S. cardiophylla* is a well-marked and stable annual, it nevertheless strongly suggests some aspects of *S. saxatilis* (see fig. 5).

S. ovata subsp. *mexicana* is probably the most extreme variant of that species and is isolated geographically. It is also the form (except possibly subsp. *bracteata*) most like the Eurasian homolog, *S. altissima,* a polymorphic complex. The morphological bridge from it to *S. arguta* and *S. saxatilis* is nearly complete. Nevertheless, *S. saxatilis* and *S. arguta* present enough stability of form to suggest their specific segregation, particularly *S. saxatilis. S. arguta* is closely connected with *S. ovata* by *S. ovata* subsp. *pseudoarguta.* The gap between *S. saxatilis* and *S. lateriflora* is wider and constant, but seems no greater than the gap between *S. Churchilliana* and its assumed ancestors. *S. ovata* is a complex unique in my experience amongst Labiatae, so diverse in habit are its extremes.

S. ovata or its prototype may also have intermixed with some member of section *Annulatae.* Both *S. Ocmulgee* and *S. incana* suggest such a possibility.

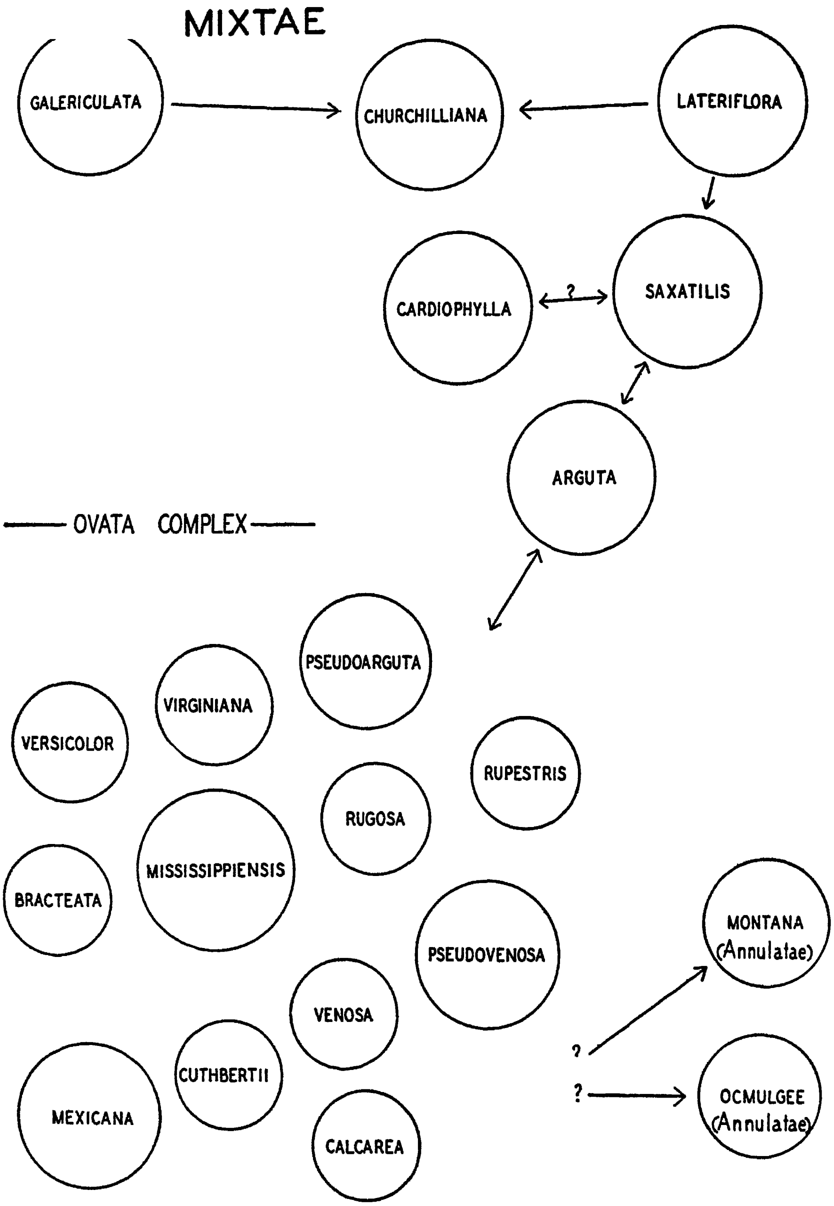


Fig. 5. Possible relationships between species of section *Mixtae*.

A specimen recently collected at Muzquiz, Coahuila (*E. Marsh* 159, Univ. Tex.) is insufficient either to describe or to refer confidently to a section. It may be referable here, as it resembles some small-leaved forms of *S. ovata*. It also resembles *S. Bolanderi* in habit, pubescence, and perhaps in flower structure.

KEY TO THE SPECIES

A. Plants perennial with creeping sometimes filiform rhizomes; petioles 2–8 mm. long; leaves narrowly ovate, rounded at the base or subtruncate; galea and tube of corolla 9–12 mm. long (usually 10 mm.); stems appressed-hirtellous and eglandular in the upper parts..20. **S. Churchilliana**

AA. Petioles rarely less than 10 mm. long, usually 12 mm. long or more; leaves broadly ovate or deltoid-ovate and usually cordate, less often rounded at the base; galea and tube of corolla 15–25 mm. long, rarely less, the lower stamens seated 7–14 mm. above the base of the tube; stems glandular in the upper parts (except *S. cardiophylla*).

B. Plants annual, strict, and stiffish..........................21. **S. cardiophylla**

BB. Plants perennial, with slender threadlike stolons.

C. Stems quite glabrous or at most sparingly clothed with appressed ascendent eglandular hairs in the middle parts; if glandular, then elsewhere; leaf blades deltoid-ovate; nutlets a warm brown, covered with papillate processes ....22. **S. saxatilis**

CC. Stems pubescent throughout, the inflorescence always glandular with spreading capitate glands, the middle and lower parts sometimes eglandular and clothed with spreading or retrorse but never ascendent hairs; leaf blades mostly ovate, scarcely deltoid.

D. Petioles from as long as to twice as long as the leaf blades; stems glandular throughout with capitate glands, bearing eglandular hairs only in the inflorescence; leaf blades sharply and strikingly serrate....23. **S. arguta**

DD. Petioles rarely longer than the blades, usually shorter; stems glandular only in the inflorescence with spreading capitate glands; or if glandular throughout, then usually accompanied by other retrorse eglandular hairs; leaf blades crenate or crenate-serrate, the teeth usually rounded ....24. **S. ovata**

20. **S. Churchilliana** Fern., Rhodora 4: 138. t. 38, fig. 1, 1902; type collected by Churchill near Fort Kent on the Aroostook River, Maine (Gray Herb.).

A perennial herb intermediate in habit between *S. galericulata* and *S. lateriflora,* spreading by slender rhizomes, its stems slender, channeled, weakly branched toward the middle or sometimes simple, rarely glabrous in lowermost internodes, more commonly sprinkled with spreading crinkled but sometimes glandular hairs, appressed-hirtellous along the angles in the upper parts; leaf blades narrowly ovate, usually 3–5 cm. long, 1–2 cm. broad, acute at the apex or acuminate, rounded at the base or subtruncate, their margins crenate-serrate, the upper surface glabrous or sparingly hirtellous, the lower similar, pallid, borne on petioles 2–8 mm. long; flowers solitary in the axils of diminished leaves or borne in the axils of bracts in few axillary racemes 3–8 cm. long; lower lip of the calyx 2.5–3 mm. long, it and the squama unseen at maturity; corolla blue, the galea and tube 9–12 (usually about 10) mm. long; filaments hirtellous below the middle, the lowermost attached somewhat above the middle of the corolla tube; nutlets not seen.

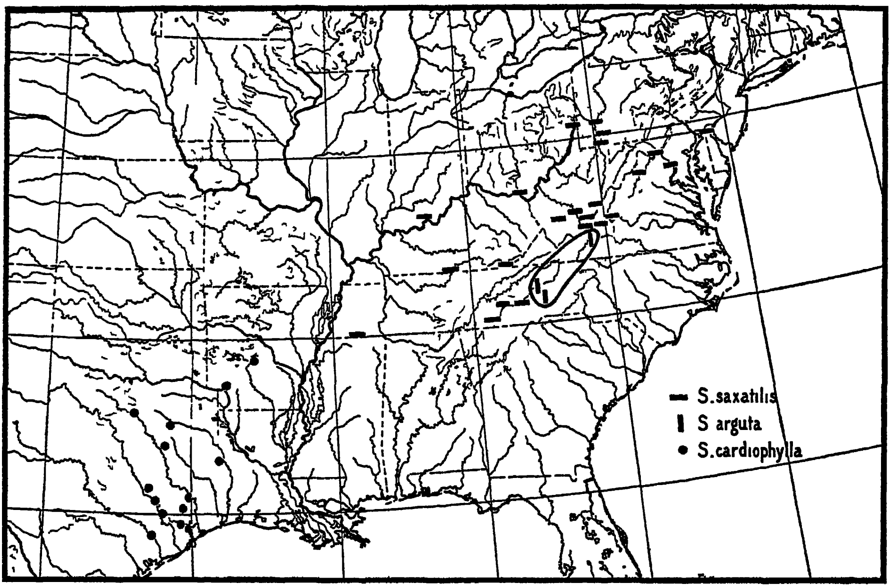
Distribution (see map 3).—New Brunswick. Carleton County: rich, wooded, alluvial river terraces, Woodstock *Fernald and Long* 14453. Quebec. Rimouski County: river banks at Bic *Bartram and Long* 510, 519.

Maine. Aroostook: river thicket, Fort Fairchild *Fernald* 2088; St. Johns River, Fort Kent *Mackenzie* 3590, 3672; river thicket, Masardis; Monticello, Meduxnakeag River *Fernald and Long* 14452; sandy alluvium, Boundary Lake, St. Francis River; Cumberland: Great Chebeague Island, Portland; Penobscot: gravelly river thicket, Bangor *Fernald and Long* 260; gravelly river thicket, Veazie *Fernald and Long* 14454.

21. **S. cardiophylla** Engelm. and Gray, Bost. Jour. Nat. Hist. 5: 227, 1845, based upon specimens collected by Lindheimer in open woods near Houston, Texas, and by Drummond (no. 209). It is difficult to assign to a single specimen the role of type. The Drummond

plants in the Gray and Torrey herbaria are fragmentary and ill-pressed. Lindheimer gathered several specimens at different times, but Engelmann did not annotate those in his own herbarium. Perhaps the best choice of a standard would be Lindheimer no. 144 in the Gray Herbarium. It is similar to a specimen in Engelmann's herbarium which bears the published data on place of collection.

An annual, 40–60 cm. tall, rather strict and stiffish, branching freely above the middle, the branches ascendent and strict, clothed with recurved, appressed hairs, particularly along the angles, sometimes with spreading glandular hairs in the lowermost parts as well; basal leaves soon deciduous, the median deltoid, lightly cordate, commonly 2–5 cm. long, crenate-dentate, the lower borne on petioles as long as the blades, the uppermost subsessile and subentire, gradually diminished upward, the upper surfaces of all glabrous, the lower hispidulous with spreading hairs, their margins usually ciliate with longer hairs; flowers produced in the upper parts of the plant in the axils of gradually diminished leaves, the pedicels clothed like the stems; flowering calyces retrorse-pubescent and ciliate on the margins, the lower lip 4–4.5 mm. long at anthesis, 5–6 mm. long at maturity, the squama about 3.5 mm. tall, concave; galea and tube 13–22 mm. (generally about 18 mm.) long, the tube pilose within, the lip glabrous; lower filaments seated 7–13 mm. (usually about 11 mm.) above the base of the tube; nutlets black, shallowly papillate.



Map 11. Distribution of *S. cardiophylla, saxatilis,* and *arguta.*

But for the variation in flower size, this species is fairly stable. The plants of Arkansas, with corollas 13–17 mm. long, may represent a small-flowered race.

Distribution (see map 11).—ARKANSAS. Garland, Hempstead *Palmer* 10503. TEXAS. Anderson *Eggert* in 1899; Brazos: *Reverchon* 770; Cherokee: *Palmer* 8606; Colorado, Dallas: *Reverchon* 770; Galveston, Harris: *Reverchon* 3910; *Drummond* 277, Henderson, Matagorda: *Tharp* 2551, Montgomery, Robertson, San Augustine: *Palmer* 7887, Smith, Walker: *Dixon* 339, 627; *Parks and Cory* 10240; *Hall* 454; Waller.

22. **S. saxatilis** Riddell, Cat. Ohio Pl. Suppl. 14, 1836, based upon specimens collected by Riddell on a dry hill 3 miles southwest of Chillicothe, Ohio, and on arid cliffs in Kentucky

opposite mouth of Scioto River; authentic specimens are in Gray, National, and Torrey herb.

S. Chamaedrys Shuttlw. ex Benth., DC. Prodr. 12: 422, 1848 (a name published in synonomy).

A perennial herb spreading by threadlike stolons, its stems commonly 20–40 cm. long, weak and slender, usually reclining, *spreading glandular in the lowermost parts, quite glabrous or sparingly hirtellous with appressed ascendent hairs in the middle parts, the inflorescence or at least the pedicels, glandular with spreading hairs and often with ascending appressed hairs,* rarely quite glabrous; lowermost leaf blades broadly ovate-cordate, tending to reniform, borne on petioles about as long as the blade, the median usually *deltoid or deltoid-ovate,* commonly 2–5 cm. long, *crenate* or serrate, borne on slender subequal petioles, passing rather abruptly into the diminished elliptical or elliptical-lanceolate *entire* floral leaves, all usually *glabrate, being ciliate on the margins,* rarely quite glabrous, rarely thinly hirsute on both surfaces; flowers disposed in slender bracteate racemes 5–15 cm. long, some frequently in the axils of the upper leaves, borne on pedicels which are *hirtellous* with usually ascendent hairs and commonly with *spreading* glandular hairs as well; flowering calyces hirtellous and glandular, similar to the pedicels, the lower lip *2–2.5* mm. long at anthesis, *4.5–5* mm. long at maturity, the squama about 3.5 mm. tall, concave; galea and tube 14–19 mm. long, the lip glabrous, the tube *sparingly pilose within along the under side;* lower stamens seated 9–10 mm. above the base of the tube; nutlets a warm brown, covered with *papillate* processes.

A form with median leaves ovate, rather than deltoid, has been collected at Rockford and at Wilmington, Delaware. A glabrate form with diminished leaves and longer petioles, has been collected near Nuttallburg, West Virginia. These forms are similar to Rugel's specimen from Warmsprings, Tennessee (*S. Chamaedrys* Shuttl.).

Distribution (see map 11).—Delaware. New Castle: Rockford, Wilmington in rocky woods. Indiana. Crawford: *Deam* 27829, 44630, 56177; wooded bluff above Ohio River 2 miles west of Fredonia *Hermann* 6679. Kentucky. Bell: Cumberland River; Fayette: Lexington; Greenup, Monroe: Mud Lick Springs. Maryland. Montgomery: Widewater in rich rocky woods *Blake* 10854; Great Falls; wooded near Locks 14 and 15 above Cabin John *Killip* 12457; Broadwater. Ohio. Jefferson: rocky hillsides near Steubenville. Pennsylvania. Allegheny: Carnot, Lashells Ferry, Natrona; Beaver: rocky slopes of Ohio River below Monaca; Fayette: Ohiopyle along roadside; Westmoreland: Jacobs Creek, barren run in back of Smithton. South Carolina. "West Point." Tennessee. Blount: Chilhowee Mountain, 2500 feet, *Curtiss* 2054; Little River; Cocke: French Broad River; Polk: Hiawasee Valley *Ruth* 519, 528, 545, 3360, 8713. Virginia. Fairfax: Difficult Run below Great Falls *Maxon* 6242; Langley; Chain Bridge *Pennell* 2487; Giles: Mountain Lake; Pulaski: along New River; Rockbridge: near Natural Bridge; Goshen Pass near Lexington; Smyth: Pond Mountain, 2100 feet; Warren: Hogback Mountain, near Brownton, 900 m. West Virginia. Boone: Uneeda; Fayette: Quinnimont, Kanawha River, Sugar Camp Hollow, Nuttallburg; Greenbrier: Alderson; Jefferson: Harpers Ferry; Monroe: Potts Mountain, 910 m. *Steele and Steele* 31; Pocahontas: Williams River, 3000 feet; Cheat Mountain.

23. **S. arguta** Buckley, Am. Jour. Sci. 45: 175, 1843, based upon specimens collected by him on Black Mountain (Mount Mitchell), North Carolina. Authentic specimens are in Gray Herbarium and herbaria of the Phila. Acad. of Nat. Sci., the Mo. Bot. Gard., and Royal Bot. Gard. at Kew.

S. saxatilis var. *arguta* Gray, Syn. Fl. 2: 379, 1878, based upon the same.

S. saxatilis var. *pilosior* Benth., DC. Prodr. 12: 423, 1848; type collected on Black Mountain (Mount Mitchell) by Rugel (Kew).

A perennial herb spreading by threadlike stolons, its stems commonly 20–40 cm. tall, commonly branching near the base and ascendent, less often reclining, glandular *through-*

out with dense spreading capitate glands and usually pubescent in the upper parts, even cinereous, with small *retrorse* eglandular hairs; lowermost leaf blades broadly ovate-cordate, tending to reniform, borne on petioles about as long as the blade, the median *ovate,* somewhat cordate at the base, commonly 2–3 cm. long, *sharply and strikingly* serrate, borne on slender petioles *as long as or even twice as long as the blade,* passing rather abruptly into the diminished *ovate and usually dentate* floral leaves, *all usually thinly hirsute* on both surfaces; flowers disposed in slender bracteate racemes 5–15 cm. long, some frequently in the axils of the upper leaves, borne on pedicels which are clothed with *retrorse glandular* hairs; flowering calyces hirtellous with spreading hairs, both small eglandular ones and longer capitate glands, the lower lip usually 3–3.5 mm. long at anthesis, *5–5.5* mm. long at maturity, the squama about 3.5 mm. tall, concave, galea and tube 15–19 mm. long, the lip glabrous, *the tube glabrous* or sparingly pilose at the base above the angle; lower stamens seated 9–10 mm. above the base of the tube; nutlets a warm brown, covered with *peglike* processes.

The meager representation found in herbaria indicates this species is stable. It is doubtless highly localized. The flowers, except for the pubescence within the tube, appear identical with those of *S. saxatilis;* however, significant differences in conformation are hard to see in dried specimens, even when boiled. As in *S. saxatilis,* the throat is seemingly open, but the general habit is more strict; the nutlets are similar, but not identical. I have seen only one example of a mature nutlet, together with three examples of immature nutlets, and not many more of *S. saxatilis.* In these examples the nutlet patterns appear significantly different, the processes of *S. saxatilis* being distinctly papillate and crowded, those of *S. arguta* more peglike and not crowded. The differences in pubescence and leaf habit appear constant. The petioles appear constantly longer in proportion to the blade.

Distribution (see map 11).—NORTH CAROLINA. Buncombe: Black Mountains *Rugel* in 1841; Montreat *Standley and Bollman* 10137; Yancey: Mount Mitchell *Biltmore Herb.* 7171. TENNESSEE. Unicoi: Unaka Springs. VIRGINIA. Giles: Glenlyn, 1600 feet; Montgomery: Blacksburg.

24. **S. ovata** Hill, Hort. Kew, ed. 1: 242, 1768, and ed. 2: 242, pl. 8, 1768, based upon a cultivated specimen; apparently no type is preserved.

S. pilosa Hill, Veg. Syst. 13: 64, 1768, based upon the same.

?*S. caroliniana* Walter, Fl. Carolin. 163, 1768, based presumably upon a specimen of the author's collection; such a specimen in the British Museum is like *S. versicolor* of Nuttall; it may represent *S. Cuthbertii.*

S. cordifolia Muhl., Cat. Pl. 56, 1813, nomen subnudum, probably the same as *S. versicolor.*

The flowers of the array dealt with here appear relatively uniform both in size and in conformation. The calyces are 3–5 mm. long at anthesis, the lower lip 5–6 mm. long at maturity. The scutellum is about 4 mm. tall and impressed. The total length of galea and tube ranges from 15–24 mm. (or less in some depauperate forms) and the lower stamens are seated 8–14 mm. above the base of the tube. There are apparently neither geographic or morphologic correlations with these extremes. In color, which is generally violet, dried specimens indicate a slight difference, for the corollas of subsp. *mexicana* and subsp. *bracteata* have a purplish or brownish tinge after drying, similar to that of the bracts. The nutlets are brown, covered with blunt or rather sharp conical pegs which are decurved and not spreading. There is occasionally an obscure banding at the base.

The pubescence is somewhat more varied. That of the inflorescence is uniform throughout; but on the leaves and on the lower, or at least the middle, part of the stems, the hair differs with locality and morphology.

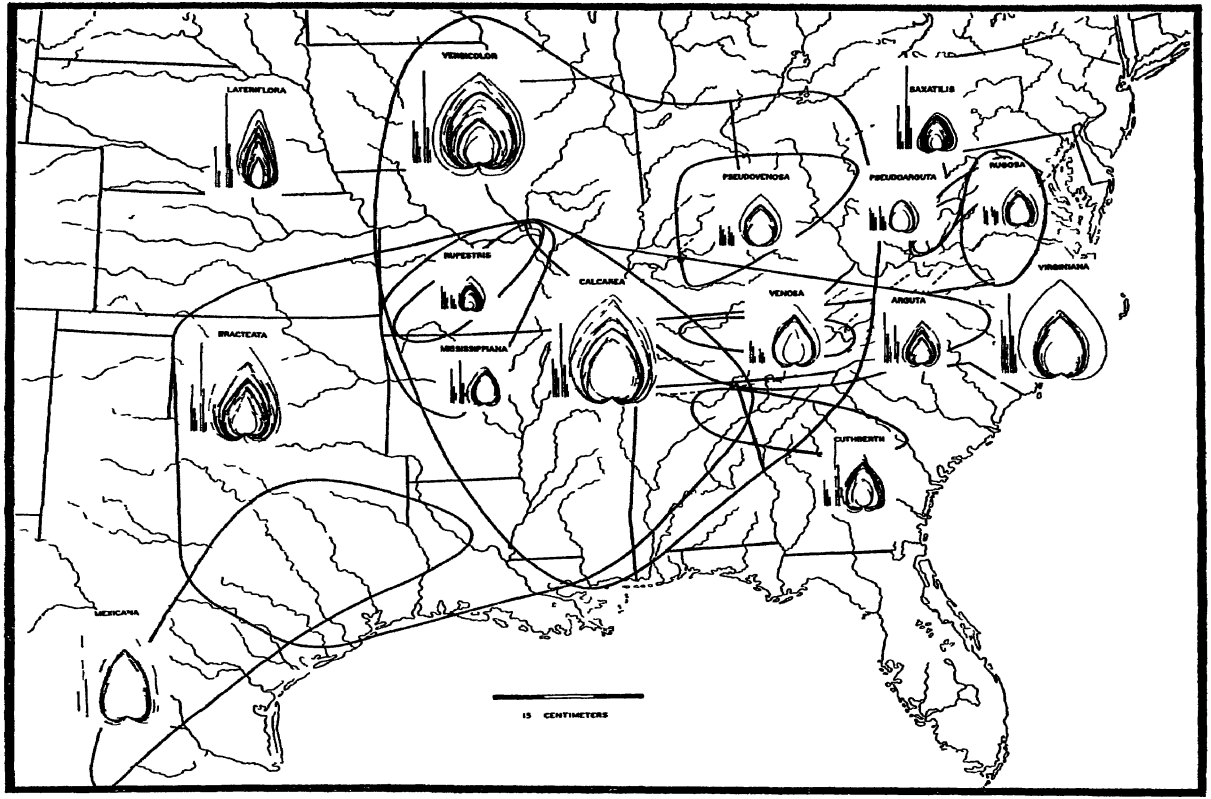
In habit, however, the array of specimens is extraordinarily variable, ranging from small decumbent or prostrate forms, which have been easily confused with *S. arguta,* to erect stout forms a meter tall with leaves 12 cm. long. Such habital forms show much geographical restriction, as illustrated by the tracings in map 11 and the following table, in which the minimum, mean, and maximum of the respective dimensions are given.

MEASUREMENTS OF SUBSPECIES OF S. OVATA
(IN MILLIMETERS)

Number of specimens	Name of subspecies	Length of leaf	Breadth of leaf	Petiole length	Internode length
60	*versicolor*.........	60–87–118	36–64–92	18–35–47	14–40–105
60	*bracteata*.........	42–66–112	29–43–57	12–26–65	11–50–103
13	*mexicana*.........	60–86–120	42–50–65	15–30–45	23–46– 98
1	*virginiana*........	52–68–118	25–47–88	33–43–62	23–43– 92
7	*Cuthbertii*........	52–55– 62	23–35–40	10–19–30	29–48– 76
26	*mississippiensis*...	18–36– 47	16–25–33	12–19–40	12–24– 50
16	*calcarea*..........	73–84–125	50–61–80	22–33–45	15–37– 85
6	*pseudovenosa*......	40–45– 58	27–32–42	12–18–23	10–14– 22
7	*venosa*............	37–58– 75	22–39–51	8–19–26	7–12– 17
3	*pseudoarguta*......	27–35– 45	17–23–30	15–20–25	10–16– 28
4	*rugosa*............	27–34– 39	18–22–28	13–16–20	15–17– 20
7	*rupestris*.........	22–28– 38	15–21–24	13–19–25	5–11– 15
50	*lateriflora*........	27–60– 87	15–29–44	6–18–42	22–51–108
50	*saxatilis*..........	13–37– 53	15–28–49	8–21–50	24–49– 96
13	*arguta*............	22–37– 58	16–26–38	20–34.5–60	18–26.5–45

Any interpretation of such an array and its arrangement into a formal classification, having been based only upon the herbarium method, can be only tentative. A large series of specimens must be compared before cleavages begin to appear. But if progress is to be made, it seems desirable to indicate as many correlations as present methods will safely permit. Therefore, at the risk of needlessly multiplying names, I have treated each of the geographical variants as a subspecies. Even at best, specific delimitation in *Scutellaria* is largely dependent upon the summation of habital difference. Pubescence is a helpful indicator. When these two aids are continuously variable, nothing much remains of useful morphological criteria.

One hesitates to suggest a cause of such diversity with the evidence available. But because of the close approach of this complex to *S. arguta* and thence to *S. lateriflora,* hybridization has probably played some part. Subsp. *bracteata* or subsp. *mexicana* appear the closest to their European homologs, and at the same time are the southernmost forms. Hybridization could have taken place at some time between these or their precursors and *S. lateriflora,*



Map 12. Outline of approximate limits of the subspecies of *S. ovata;* broken lines show approximate limits of *S. arguta* and *saxatilis.* Inserted drawings illustrate range of variation in leaf size and shape by showing outlines of a series of leaves traced upon the largest leaf of each specimen chosen. The mean size and shape is shown by a heavy line. Bars to left of each leaf show minimum, maximum, and mean lengths of leaf petioles and corresponding internodes. Numerical data are summarized in accompanying table.

and the present array may be a heteroploid complex, which has spread northward since glaciation. West of the Mississippi and north of the Ohio its distribution is general; eastward it seems localized and infrequent (see map 12). Like *S. arguta* and *S. saxatilis,* the whole complex seems to spread by means of very slender, even filiform, rootstocks. Hence asexual reproduction may have been a factor in the persistence of some forms.

KEY TO THE SUBSPECIES

A. Middle and usually the lower parts of the stem below the inflorescence pubescent with decurved or retrorse eglandular hairs; if somewhat glandular, not notably so.
  B. Plants ranging from Louisiana to Nuevo Leon, the hair of the lower part of the stem relatively long, decurved; bracts purplish, drying brownish *d.* subsp. **mexicana**
  BB. Plants of the Appalachian Mountains or at least lying east of the Mississippi River.
    C. Plants 10–30 cm. tall, rarely more, lower parts of the stem clothed with small curled hairs, the lower surface of the leaves similarly clothed chiefly along the veins; plants of Tennessee and adjacent North Carolina (see also *j.* subsp. *pseudoarguta*) .... *h.* subsp. **venosa**
    CC. Plants usually more than 20 cm. tall.
      D. Largest leaves 5–6.5 cm. long; petioles averaging about half the length of the corresponding internodes; lower part of stem and lower leaf surface clothed with longish retrorse eglandular hairs; plants of Alabama and Georgia.................................. *e.* subsp. **Cuthbertii**
      DD. Largest leaves 7–12 cm. long; petioles averaging nearly as long as the corresponding internodes; lower part of stem and lower leaf surface (chiefly along the veins) clothed with curled hairs; plants of Tennessee, North Carolina, and Kentucky..................... *g.* subsp. **calcarea**

AA. Stems glandular throughout with spreading capitate glands and usually with shorter somewhat retrorse eglandular hairs.
  E. Plants usually less than 30 cm. tall, often lax, even decumbent, tending often to branch in the lower parts; largest leaf blades 2–5, rarely 6 cm. long.
    F. Plants of West Virginia or adjacent regions.
      G. Plants erect, with the habit of *S. arguta;* leaves acuminate, the upper surfaces glabrate; petioles usually longer than the internodes they subtend....... *j.* subsp. **pseudoarguta**
      GG. Plants decumbent or lax; leaves usually obtuse or rounded at the apex, the upper surfaces hirsute; petioles about equaling the internodes................. *k.* subsp. **rugosa**
    FF. Plants of the Ohio and Mississippi river valleys, not montane.
      H. Plants erect, the internodes usually more than 1.5 cm. long; flowers in the axils of well-defined bracts.
        I. Largest leaves crowded toward the inflorescence, the leaf blades usually twice as long, the petioles as long as or longer than the internodes; plants of Ohio, Kentucky, and Indiana *i.* subsp. **pseudovenosa**
        II. Largest leaves near the middle of the stem or near the inflorescence, but not crowded, their blades longer than the internodes, but seldom twice as long, the petioles shorter than the internodes; plants of Illinois, Missouri and Arkansas *c.* subsp. **mississippiensis**

HH. Plants decumbent or low, the internodes usually less than 2 cm. long, the flowers commonly in the axils of little modified leaves or leaflike bracts; plants of Missouri and adjacent Arkansas .... *l.* subsp. **rupestris**

EE. Plants usually more than 30 cm. tall, erect, branching only in the inflorescence; largest leaf blades 4–11 cm. long, mostly 6 cm. or more.

J. Bracts apparently purplish, drying brownish, usually exceeding the calyces, even exceeding the flowers; leaves glandular, usually puckered; petioles averaging about half as long as the internodes; widespread in the lower Mississippi Valley .... *b.* subsp. **bracteata**

JJ. Bracts green, usually exceeded by the calyces; leaves eglandular, thin and smooth, not puckered; petioles averaging about equal to the internodes.

K. Lower surfaces of leaves thinly covered with usually capitate-glandular hairs and with shorter eglandular hairs along the veins, the intervenous tissue glabrate; plants of Virginia .... *f.* subsp. **virginiana**

KK. Lower surfaces of leaves well covered with straightish hairs on the veins and shorter somewhat curled eglandular hairs on the intervenous tissue; plants widespread in the Mississippi and Ohio river valleys .... *a.* subsp. **versicolor**

24*a*. Subsp. **versicolor** comb. nov.

S. versicolor Nutt., Gen. Pl. 2: 38, 1818, based upon a collection made by Nuttall in Ohio; authentic specimens in Brit. Mus. Nat. Hist. and in herb. Phila. Acad. Nat. Sci.

Commonly 30–50 cm. tall, erect, the stems branching only in the inflorescence if at all, softly pilose throughout with somewhat retrorse, but not appressed hairs, some of which are capitate-glandular; largest leaves borne near the inflorescence, crowded, the lower more remote, soon deciduous; leaf blades thin, broadly ovate-cordate, 60–118 mm. long,* 36–92 mm. broad, averaging about 9 cm. long, 6.5 cm. broad, their margins evenly convex, regularly crenate-serrate, the upper surfaces thinly hirsute with longer hairs, rarely glabrous, the lower pubescent with shorter hairs, those of the veins spreading, those of the intervenous tissue shorter and somewhat curled; petioles 18–47 mm. long, averaging 3.5 cm., the corresponding internodes 14–105 mm., averaging about 4 cm.; inflorescence or its branches commonly 10–15 cm. long, the bracts green, usually exceeded by the calyces.

Distribution (see map 13).—Alabama. Butler, Madison, Mobile. Arkansas. Pulaski. Georgia. Catoosa. Illinois. Adams, Clinton, Fulton, Hancock, Henderson, Jackson, Jo Daviess, La Salle, Mercer, Menard, Peoria, St. Clair, Will, Winnebago. Indiana. Adams: *Deam* 40914; Brown: *Deam* 11187; Clark, Crawford, Dearborn: *Deam* 6865; Delaware, Floyd, Gibson: *Deam* 16939; Greene, Jefferson, Posey, Wabash: *Deam* 2218; Warrick, Washington, Wells, Whitley. Iowa. Decatur, Johnson, Muscatine, Scott, Van Buren. Kentucky. Fayette, Franklin, Nelson, Warren, Whitehouse. Louisiana. East Feliciana, Natchitoches: *Correll and Correll* 9740; Rapides: *Palmer* 7601; Vermillion. Minnesota. Winona. Missouri. Christian, Clay: *Bush* 12687; De Kalb: *Bush* 5851; Franklin, Greene, Jackson: *Bush* 484, 725, 9792; *Mackenzie* 338; Jefferson: *Steyermark* 1241; Lewis, Marion: *Davis* 7520; Morgan: *Steyermark* 13193; Phelps, Pike: *Davis* 1535, 3638; St. Louis, Taney. North Carolina. Jackson. Ohio. Butler, Erie, Franklin, Hamilton: *Lloyd* 418; Lorain, Lucas, Ross. South Carolina. Anderson. Tennessee. Davidson, Franklin, Hamilton. Virginia. Mecklenberg, Montgomery, Warren. Wisconsin. Crawford, Dodge, Grant: *Fassett* 12581, 17600; Milwaukee, Pierce, Sauk, Vernon.

24*b*. Subsp. **bracteata** subsp. nov.

S. versicolor var. *bracteata* Benth., Lab. Gen. et Sp. 433, 1834; type collected on Rio Brazos, Texas, by Drummond (Kew).

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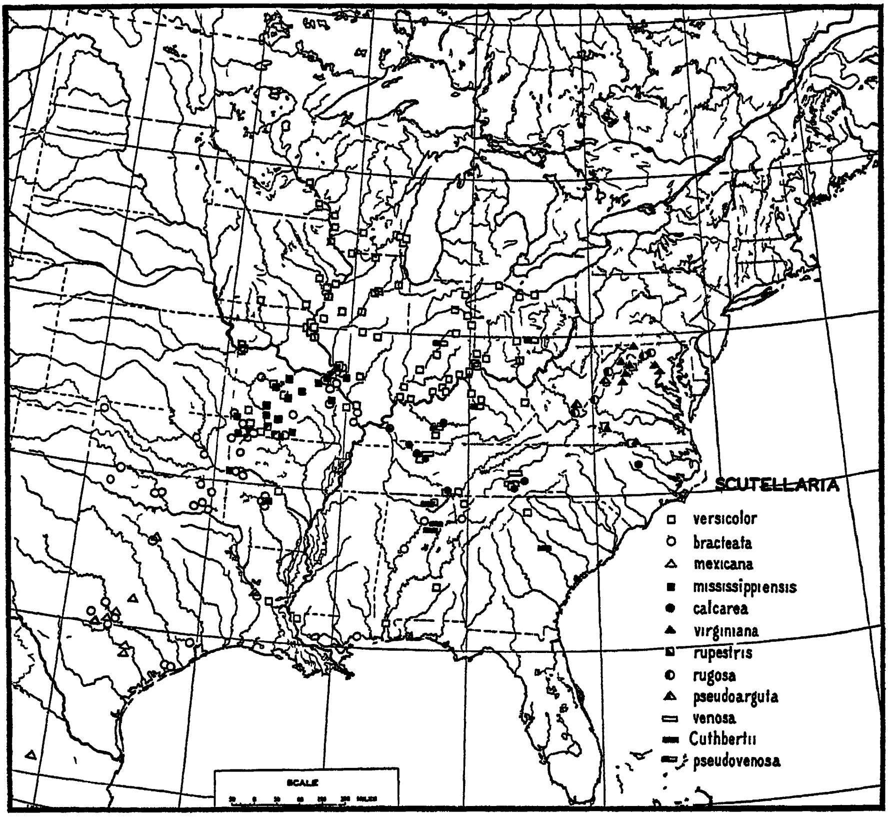
* The measurements of leaves refer to the largest leaves upon the plant; such leaves are usually median, near the base of the inflorescence.

S. ovata var. *bracteata* Blake, Rhodora 17: 134, 1915.

S. cordifolia var. *pilosissima* Mack. and Bush, Trans. Acad. St. Louis 12: 84, 1902; type collected by Bush (no. 190) at Eagle Rock, Missouri (Mo. Bot. Gard.).

S. versicolor var. *mollis* Nutt., Trans. Am. Phil. Soc. 5: 188, 1837; type collected by Nuttall on the Red River, Arkansas (Brit. Mus.).

Commonly 30–60 cm. tall, erect, the stems branching chiefly in the inflorescence, softly pilose throughout with spreading capitate glands and shorter hairs, these somewhat retrorse below, but not appressed; largest leaves borne near the middle of the stem, or toward the inflorescence, but not crowded there, more or less equally distributed throughout, the lowermost more persistent; leaf blades thicker, ovate-cordate, more or less puckered, 42–112 mm. long, averaging about 6.5 cm., 29–57 mm. broad, averaging about 4.5 cm., their margins convex or tending to be flattened above the middle, crenate-serrate or serrate, the upper surfaces hirsute with longer hairs, often glandular, the lower pubescent with shorter hairs, those of the veins spreading, those of the intervenous tissue shorter and somewhat curled, often with longer spreading capitate glands as well; petioles 12–65 mm. long, averaging about 2.5 cm., the corresponding internodes 11–103 mm., averaging about 5 cm.; inflorescence commonly paniculate, its branches frequently 20 or 25 cm. long, the bracts apparently purplish, drying brownish, usually exceeding the calyces or even the flowers.



Map 13. Distribution of subspecies of *S. ovata*.

Distribution (see map 13).—ALABAMA. Blount, Tuscaloosa. ARKANSAS. Benton, Carroll: *Bush* 15074; Garland: *Runyon* 1166; Hot Springs: *Demaree* 15335; Marion: *Palmer* 5912; Sebastian: *Demaree* 3122; Washington: *Palmer* 8211. GEORGIA. Floyd. ILLINOIS. Jackson: *Gleason* 2616. KANSAS. Cherokee: *Rydberg and Imler* 214, 229. LOUISIANA.

Natchitoches: *Palmer* 7966. MISSISSIPPI. Claiborne: *Tracy* 4898; Harrison: *Tracy and Lloyd* 578. MISSOURI. Barry: *Bush* 190; *Palmer* 32648; Benton: *Palmer* 36775; Cape Girardeau: *Palmer* 18017; Douglas: *Steyermark* 14677; Hickory: *Steyermark* 13311; Iron, Jasper: *Palmer* 931, 18196; Jefferson, Laclede: *Steyermark* 13926; McDonald: *Bush* 303; Morgan: *Bush* 14965; Ozark, Pettis: *Bush* 13755; St. Louis, Stone: *Bush* 15059, 15677; Washington: *Eggert* in 1893. OKLAHOMA. Caddo, Choctaw, Harper, Le Flore: *Stevens* 2732; Murray. TEXAS. Burnet, Comal, Dallas, Gillespie, Harris, Hays, Llano, Matagorda, Travis.

24*c*. Subsp. **mississippiensis** comb. nov.

S. mississippiensis Martens, Bull. Acad. Brux. Roy. 8: 66, 1841; type collected near St. Louis, Missouri, by Père Duerinck; authentic material in herb. of the Mo. Bot. Gard.

Infrequently as much as 30 cm., often 15–20 cm. tall, lax and often decumbent, tending to branch irregularly throughout, glandular with spreading capitate glands and usually shorter eglandular hairs; largest leaves often borne near the inflorescence, but not usually crowded there, the leaf size irregular and diverse upon a given plant; leaf blades 18–47 mm. long, averaging about 3.5 cm., 16–33 mm. broad, averaging about 2.5 cm., the habit suggesting subsp. *bracteata* in some specimens, subsp. *rupestris* in others, in general thickish and puckered, their margins crenate-serrate, tending to be convex and shortly, even sharply, acuminate at the apex but sometimes rounded, lightly cordate or rounded at the base, the pubescence about as in subsp. *bracteata*, the small hairs fewer; petioles 12–40 mm. long, averaging about 2 cm., the corresponding internodes 12–50 mm. long, averaging about 2.5 cm. long, the bracts usually exceeding the calyces, even leaflike and petiolate, the flowers rarely axillary in the upper leaves.

Distribution (see map 13).—ARKANSAS. Garland: Hot Springs *Bunyon* 1462; Sebastian: Fort Smith *Bigelow*. ILLINOIS. Jackson: Grand Tower *Gleason* 1842; St. Clair: Falling Spring *Steyermark* 609; Union: Pine Hills *Earle*. MISSOURI. Barry: Shell Mound *E. J. Palmer* 32648; Eagle Rock: *Kellogg* 1154; Camden: Linn Creek *Emig* 165; Franklin: Pacific *Ohlweiler;* Greene: Valley Mills *Standley;* Howell: Bly *Steyermark* 14424; Iron: Ironton *E. J. Palmer* 19537; Jasper: Joplin *E. J. Palmer* 828; Maries: Spring Creek *Steyermark* 15315; Miller: Marys Home *Steyermark* 13102; Ozark: Pontiac *E. J. Palmer* 34776; Phelps: Jerome *Kellogg;* St. Louis: environs of St. Louis *Duerinck*, Allenton *Letterman;* Washington: Irondale *Russell;* Wright: Cedar Gap *Bush* 19171. OKLAHOMA. Bryan: Caddo *Sheldon* 47; ?Murray: False Washita between Fort Cobb and Fort Arbuckle *E. J. Palmer* 241.

24*d*. Subsp. **mexicana** subsp. nov.; type collected by Pringle (no. 2219) near Monterrey, Nuevo Leon, Mexico (Gray Herb.).

Commonly 40–60 cm. tall, erect, the stems branching only in the inflorescence if at all, softly pilose in the upper parts with spreading capitate-glandular hairs and shorter somewhat retrorse eglandular ones, mostly eglandular below the inflorescence, the hairs decurved and even subappressed; largest leaves borne near the inflorescence or near the middle of the stem, not crowded, the lower tending to persist; leaf blades thin, scarcely puckered, tending to be deltoid-ovate, acutish at the apex, cordate at the base, the margins flattened above the middle, crenate-serrate, 60–120 mm. long, averaging about 8.5 cm., 42–65 mm. broad, averaging about 5 cm., the upper surfaces thinly hirsute with longer hairs, the lower mostly clothed with spreading hairs not much shorter than those above; petioles 15–45 mm. long, averaging about 3 cm., the corresponding internodes 23–98 mm. long, averaging about 4.5 cm. long; inflorescence paniculate, the branches 10–20 cm. long or more, the bracts purplish, drying brownish, usually exceeding the calyces.

Distribution (see map 13).—MEXICO. NUEVO LEON. Sierra Madre near Monterrey *Pringle* 2219; *Mueller and Mueller* 150; COAHUILA: Musquiz, Yerda Spring *Marsh* 273.

LOUISIANA. Natchitoches: sandy woods near Chopin *E. J. Palmer*. TEXAS. Anderson: Athens, Palestine *Tharp;* Bell: 6 miles north of Belton *Wolff* 860; Bexar: 25 miles north of San Antonio at Gutzeit Ranch *Schulz* 538; 19 miles west of San Antonio *Schulz* 2418;

San Antonio *Havard;* Dallas: Coombs Branch, Dallas *Reverchon* 2531. Gonzalez: *Normand; Bousch* 1503; Hays: San Marcos *E. J. Palmer* 12111, 33890; Kerr: 12 miles southwest of Kerrville *Parks and Cory* 23516; Travis: Big Bee Creek, 30 miles west of Austin *Tharp.*

24*e*. Subsp. **Cuthbertii** comb. nov.

S. Cuthbertii Alexander, *in* Small, Man. SE. U. S. 1151, 1933; type collected by A. Cuthbert (no. 275) near Augusta, Georgia (N. Y. Bot. Gard.).

S. cordifolia var. *minor* Mohr, Contrib. U. S. Natl. Herb. 6: 703, 1901; the specimens cited by Mohr are referable here.

(?) *S. versicolor* var. *minor* Chapman, Fl. South. U. S. 323, 1860; the type is uncertain, perhaps lost.

S. ovata var. *pilosior* Leon., Contrib. U. S. Natl. Herb. 22: 735, 1927, not Bentham.

Slender, 30–50 cm. tall, erect, branching only in the inflorescence, if at all; pubescence about like in subsp. *mexicana*, spreading pilose-glandular with shorter eglandular hairs in the inflorescence, clothed below the inflorescence with decurved or retrorse longish but mostly eglandular hairs; leaf blades rather thickish but scarcely puckered, ovate-cordate, mostly obtuse at the apex, 52–62 mm. long, averaging about 5.5 cm., 23–40 mm. broad, averaging about 3.5 cm., their margins rather more finely crenate-serrate, the upper surfaces hirsute, somewhat glandular, the lower about as in subsp. *mexicana* but somewhat glandular; petioles 10–30 mm. long, averaging about 2 cm., the corresponding internodes 29–76 mm. long, averaging about 5 cm.; inflorescence simple or with a pair of auxiliary branches, not otherwise paniculate, the bracts about equaling the calyces.

Distribution (see map 13).—ALABAMA. Jefferson: Birmingham *Earle;* Lee: Auburn *Earle* 2056; *Earle and Baker;* Madison: Gurley *Mohr; Earle and Underwood;* GEORGIA. Richmond: Augusta *Cuthbert* 275.

24*f*. Subsp. **virginiana** subsp. nov.; type collected by Wm. Palmer (no. 60) on the Peaks of Otter, Bedford County, Virginia (Univ. Calif., L. A.).

Commonly 30–50 cm. tall, erect, the stems branching chiefly in the inflorescence, spreading glandular-pilose throughout, clothed also with shorter hairs which are somewhat retrorse in the lower parts; largest leaves borne near the inflorescence, sometimes crowded, the lowermost usually soon deciduous; leaf blades thin, broadly ovate-cordate, nicely cordate at the base, 52–118 mm. long, averaging about 7 cm., 25–88 mm. broad, averaging about 4.5–5 cm., their margins evenly convex, obtuse or acute at the apex, regularly crenate-serrate, the upper surfaces thinly hirsute with longer hairs, hardly glandular, the lower thinly clothed with spreading capitate-glandular hairs and usually shorter hairs subappressed along the veins, the intervenous tissue often glabrate; petioles 33–62 mm. long, averaging about 4.5 cm., the corresponding internodes 22–92 mm. long, averaging about the same as the petioles; inflorescence usually paniculate, its branches 10–15 cm. long, the bracts usually less than the calyces.

Distribution (see map 13).—MARYLAND. Washington: Round Top *Shreve and Jones* 704. VIRGINIA. Augusta: Staunton *Pursh;* Bedford: Peaks of Otter *Wm. Palmer* 60, 161; Fairfax: old canal by Falls *Norton* 265; 18 miles north of Bedford *Murrill;* Peaks of Otter *Curtiss;* Mecklenberg: Cuscowilla *Meredith;* Page: South Marshall Mountain *Allard* 758; Pulaski: near Reed; Rockingham: Swift Run *F. L. J. Boettcher* 502; Surry: Claremont Wharf *Fernald and Long* 8436; Warren: Buckton *Miller.* WEST VIRGINIA. Hampshire: Hanging Rock *Frye* 1075.

24*g*. Subsp. calcarea subsp. nov.; type collected in woods at Whites Bend, Davidson County, Tennessee, and distributed by the Biltmore Herb. as no. 3450a (Univ. Calif. L. A.).

Commonly 30–50 cm. tall, erect but seemingly rather lax and not strict, branching only in the inflorescence if at all, pilose in the inflorescence with spreading capitate glands and shorter eglandular usually spreading hairs as well, thinly pubescent below the inflorescence with short downwardly curled hairs, not at all glandular unless toward the base; largest leaves borne toward the inflorescence and often crowded there, the lower appearing to be soon deciduous; leaf blades thin, ovate-cordate, 73–125 mm. long, averaging about 8.5 cm., 50–80 mm. broad, averaging about 6 cm., their margins rather evenly convex, regularly crenate-serrate, the upper surfaces quite glabrous, or thinly hirsute, the lower thinly pubescent with shorter hairs retrorse along the veins, the intervenous tissue glabrate, mostly eglandular, petioles 22–45 mm. long, averaging about 3.5 cm., the corresponding internodes 15–85 mm., averaging about 3.5–4 cm.; inflorescence simple or paniculate, the bracts mostly exceeded by the calyces.

Distribution (see map 13).—KENTUCKY. Edmonson: Mammoth Cave *E. J. Palmer;* Fayette: Lexington *Short* 433; Lyon: Kuttawa *Eggleston* 4552, 4630. NORTH CAROLINA. Jackson: Cullowhee *Thaxter;* Mitchell: Roan Mountain *J. D. Smith; T. Meehan.* SOUTH CAROLINA. Greenville: Saluda Mountains *Gibbes.* TENNESSEE. Davidson: White Bend *Biltmore Herb.* 3450; Nashville *Bicknell;* bluffs near Nashville *Gattinger;* Franklin: Sherwood *Eggert;* Montgomery: Clarksville *E. J. Palmer* 17640; Roane: Middle Creek *Gattinger.*

24*h*. Subsp. **venosa** comb. nov.

S. venosa Kearney, Bull. Torrey Bot. Club 24: 571, 1897; type collected by Kearney (no. 873) on Bluff Mountain, Cocke County, Tennessee (U. S. Natl. Herb.).

Commonly 10–30 cm. tall, the stems branching only in the inflorescence if at all, pilose with spreading capitate glands and slender somewhat retrorse eglandular hairs in the inflorescence, pubescent below with small downwardly curled hairs; largest leaves borne near the inflorescence, crowded there, the lowermost sometimes deciduous; leaf blades thin, hardly puckered, but the veins often prominent and often purple, ovate, lightly cordate at the base, acute at the apex, 37–75 mm. long, averaging about 6 cm., 22–51 mm. broad, averaging about 4 cm., the margins rather evenly convex, crenate-serrate, the upper surfaces glabrous or thinly hirsute, the lower thinly clothed chiefly along the veins with somewhat curled hairs; petioles 8–26 mm. long, averaging about 2 cm., the corresponding internodes 7–17 mm., averaging somewhat more than 1 cm. long; inflorescence mostly simple or sometimes with a pair of auxiliary branches generally 3–10 cm. long, the bracts plainly exceeded by the calyces.

Distribution (see map 13).—NORTH CAROLINA. Buncombe: Craggy Mountains *Rydberg* 9457; Haywood: Eagles Nest, near Waynesville *Standley* 5617; Rockingham: Reidsville *Le Roy.* TENNESSEE. Cocke: Bluff Mountain *Kearney* 873; Davidson: Nashville *E. P. Bicknell* in 1894.

24*i*. Subsp. **pseudovenosa** subsp. nov.; type collected by H. L. Jones at Granville, Ohio (Oberlin).

Similar to subsp. *venosa* in habit, suggesting a depauperate form of subsp. *versicolor*, the pubescence of the stem spreading-glandular throughout, with shorter somewhat retrorse hairs; leaf blades 40–58 mm. long, averaging about 4.5 cm., 24–42 mm. broad, averaging something more than 3 cm., more or less pilose and glandular on both surfaces; petioles 12–23 mm. long, averaging about 8 mm., the corresponding internodes 10–22 mm. long, averaging about 14 mm.; inflorescence about as in subsp. *venosa.*

Distribution (see map 13).—INDIANA. Marion: Indianapolis *Britton;* White River. KENTUCKY. Jessamine: woods near Camp Nelson *McFarland* 87; Nelson: without locality *Sister Rose Agnes;* Warren: Bowling Green *Price.* OHIO. Licking: Granville *H. L. Jones;* Erie: Cedar Point *York;* Johnsons Island *York.*

24*j*. Subsp. **pseudoarguta** subsp. nov.; type collected by E. L. Core on Kates Mountain, Greenbrier County, West Virginia (U. West Va.).

Commonly 10–30 cm. tall, suggesting a hybrid with one of the lesser forms of this species and *S. arguta,* the stems slender and erect, but lax, pilose throughout with spreading capitate glands and shorter somewhat retrorse ones, or eglandular in the middle parts after the manner of *S. arguta;* largest leaves toward the inflorescence, 27–45 mm. long, averaging about 3.5 cm., 17–30 mm. broad, averaging about 2.5 cm., somewhat puckery, shortly acuminate at the apex, rounded at the base but hardly cordate, the margins strongly convex, rather closely crenate-serrate, the upper surfaces glabrous, the lower pubescent chiefly along the veins with retrorse eglandular hairs; petioles 15–25 mm. long, averaging about 2 cm., the corresponding internodes 10–28 mm. long, averaging about 1.5 cm.; inflorescence simple or branched, 5–15 cm. long, the bracts about equal to the calyces.

Distribution (see map 13).—WEST VIRGINIA. Greenbrier: Kates Mountain *Core* 4277; *W. Va. Univ. Exped.* 638; Pendleton: Brandywine *Core* 3663.

24*k*. Subsp. **rugosa** comb. nov.

S. rugosa Wood, Class Book, ed. 2, 424, 1847, based upon a collection made at Harpers Ferry, West Virginia; material possibly authentic in Gray Herb.

Lax, more or less decumbent, tending to branch in the lower parts, the stems pilose throughout with spreading capitate-glandular hairs and shorter somewhat retrorse eglandular ones; largest leaves borne near the inflorescence, but the leaf size diverse; leaf blades somewhat puckered, ovate, commonly obtuse, rounded at the base and lightly cordate or not at all, 27–39 mm. long, averaging about 3.5 cm., 18–28 mm. broad, averaging somewhat more than 2 cm., the margins rather convex, mostly crenate or crenate-serrate, the upper surfaces hirsute and somewhat glandular, the lower thinly covered, chiefly on the veins, with spreading or retrorse hairs, more or less glandular; petioles 13–20 mm. long, averaging about 1.5 cm., the corresponding internodes 15–20 mm. long, averaging about 17 mm.; inflorescence usually racemose, the racemes frequently axillary, 8–10 cm. long, or the flowers in the upper diminished leaves, the bracts about equalling the calyces.

Distribution (see map 13).—VIRGINIA. Giles: Peters Mountain, north of Narrows *Fogg* 1505*a;* Montgomery: Great Falls of Potomac *Baxter.* WEST VIRGINIA. Bath: Millboro *Steele;* Grant: North Mill Creek *W. Va. Univ. Exped.;* Jefferson: Maryland Heights *Steele;* Harpers Ferry *Wood; Aiken;* Summers: Great Tunnel Mountain *Morris.*

24*l*. Subsp. **rupestris** subsp. nov.; type collected by B. F. Bush (no. 791) at Eagle Rock, Missouri (U. S. Nat. Herb.).

A low decumbent or prostrate herb, branching throughout, with slender lax stems that are pilose throughout with spreading capitate-glandular hairs and shorter, somewhat retrorse eglandular ones; leaves irregular and diverse in size, their blades thin, ovate, generally obtuse or rounded at the apex, rounded or subcordate at the base, their margins crenate or crenate-serrate, convex, 22–38 mm. long, averaging less than 3 cm., 15–24 mm. broad, averaging about 2 cm., the upper surface thinly hirsute or glabrous, the lower with similar spreading hairs somewhat shorter, chiefly along the veins; petioles 13–25 mm. long, averaging somewhat less than 2 cm., the corresponding internodes 5–15 mm. long, averaging somewhat more than 11 mm.; flowers usually axillary in the leaves even to the middle of the plant, less often racemose, the bracts then conspicuous and leaflike.

Distribution (see map 13).—ARKANSAS. Marion: Cliffs on White River near Cotter *E. J. Palmer* 4750, 43871, 43870. MISSOURI. Barry: Roaring River *Trelease* 1144; Eagle Rock *Bush* 791; *Mackenzie;* Ozark: Pontiac *E. J. Palmer* 33117; St. Louis: Fern Glen *Edmonds* (? subsp. *mississippiensis*); Taney: Taneyville *Trelease* 721.

SECTION V. **Resinosae**

Low xeric perennials with several or numerous stems arising from a woody crown; three species annual. Leaves small, oblong, tending to be rotund and usually entire. Flowers axillary in the upper half of the plant, the floral leaves being diminished but scarcely bractlike. Scutellum impressed at maturity, usually broader than tall, and flaring. Corolla violet-blue, the lower lip usually having a white-speckled blotch, its upper lip usually strongly galeate

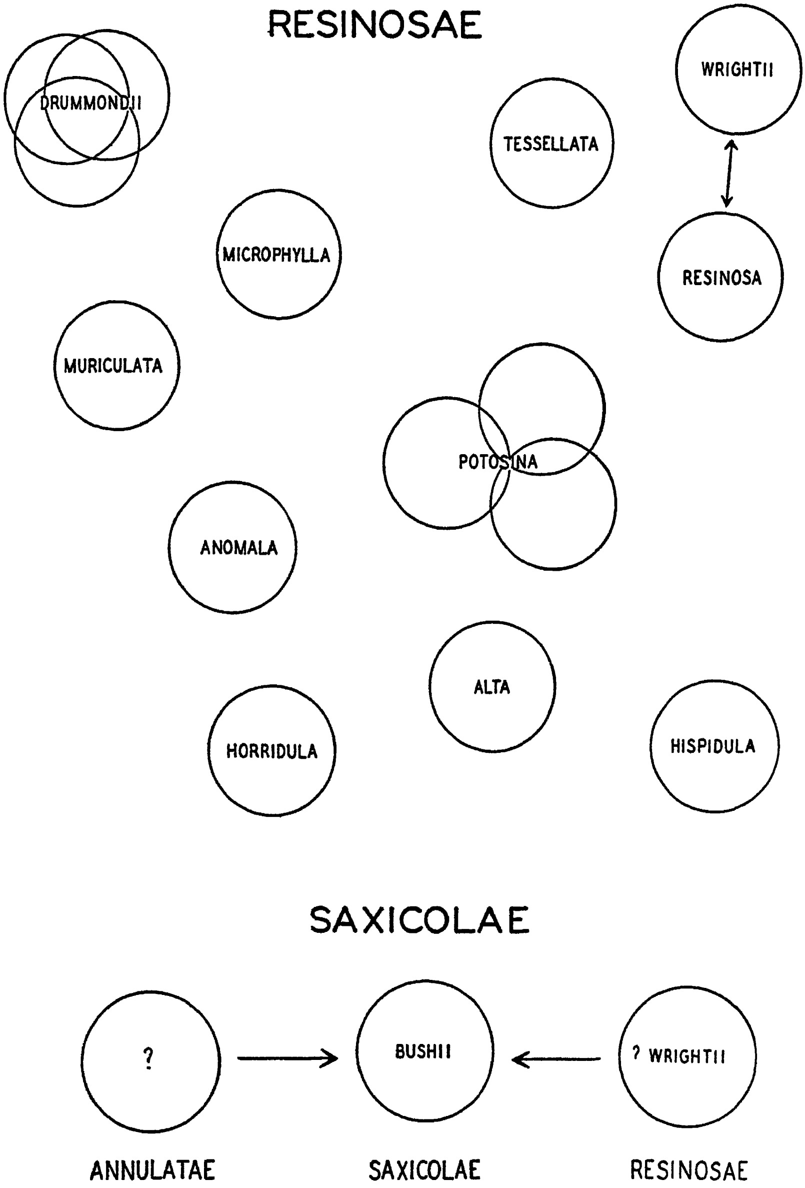


Fig. 6. Possible relationships in sections *Resinosae* and *Saxicolae*.

and usually pilose within in two patches. Corolla tube pilose within, usually below the point of attachment of the stamens, sometimes broadly annulate. Lower stamens attached near the middle of the tube. Nutlets granulose, tessellate, paxillate, or covered with subimbricated lamellae. The type species is *S. resinosa* Torr.

This section consists of eleven species (see fig. 6) which range from Kansas to central Mexico and westward to Arizona. Of all the American Scutellarias they occupy the most arid situations and are the most xeric in growth form. Of these eleven species two are ephemeral annuals and one may apparently be either annual or perennial. The remaining eight are very similar in growth form and habit. They differ chiefly in the size and shape of the leaves, the nature of the pubescence, the degree of hairiness of the corolla tube and the pattern of the nutlets. All of these differentiating characters do not necessarily differ simultaneously and since the degree of difference is never very large, specific lines are accordingly difficult to establish. Perhaps some should be treated as subspecies. Yet experience with other sections suggests that they are probably species, morphologically differentiated in the mode, but still with sufficient heterogeneity to form an overlapping pattern. Only experiment and field study can determine the degree to which they are actually cut off from an exchange of genes.

Two collections made at Musquiz, Coahuila, by March (Herb. Univ. Texas) represent two probable species in addition to those described below. The material is hardly adequate to place them properly, and it seems preferable to delay their publication until more is at hand. One has been given a herbarium name by P. C. Standley which suggests its general resemblance to *Lythrum*. It is characterized by rather firm, nearly sessile leaves 1–2 cm. long, which are ovate-lanceolate and entire. The other has nicely ovate leaves of about the same length, which are crenate-serrate and petiolate. Both are seemingly perennial and the pubescence of both is spreading, and is somewhat glandular on the latter, which suggests some of the diminutive forms of *S. ovata*.

KEY TO THE SPECIES

A. Pubescence clearly ascendent—curled or pointed upward on the stems and calyces.

  B. Pubescence dense and more or less glandular; galea and tube 18 mm. long .... 29. **S. anomala**

  BB. Pubescence sparse, not glandular unless with sessile glands; galea and tube about 12 mm. long.

    C. Leaves oval or ovate, subsessile, the median commonly about 1 cm. long; corolla tube nearly glabrous within........................31. **S. hispidula**

    CC. Leaves deltoid-ovate, the lower petioles 8–10 mm. long, the median 1.5–2 cm. long; corolla tube densely pilose within near the mouth of the calyx .... 30. **S. alta**

AA. Pubescence spreading, decurved or retrorse, not ascendent.

  B. Plants annual, the pubescence spreading or small and decurved.

    C. Nutlets covered with blunt, subimbricated squamellae; hairs spreading, commonly glandular, as long as half the thickness of the stem or more; corolla tube pilose near the attachment of the lower stamens; plants predominantly Texan...33. **S. Drummondii**

    CC. Nutlets covered with sharp conical processes; hairs small, decurved, eglandular; corolla tube pubescent and subannulate near the attachment of the lower stamens; known only from coastal areas in southeastern Texas .... 35. **S. muriculata**

    CCC. Nutlets finely granulose, the protuberances blunt and rounded; hairs spreading and glandular, often as long as the thickness of the stem; corolla tube hirtellous within but scarcely annulate; chiefly Mexican but found in Texas also...34. **S. microphylla**

BB. Plants perennial, usually with several or numerous stems arising from a woody crown.

C. Stems and calyces sparingly pilose-villous with rather stout hairs, not glandular; corolla tube glabrous within or nearly so; nutlets covered with peglike processes ....32. **S. horridula**

CC. Stems and calyces variously pubescent; if clothed with spreading hairs, these rigid; corolla tube pubescent, even annulate within; nutlets granulose or tessellate, i.e., the protuberances flattened to give a mosaic appearance.

D. Pubescence minute, of downwardly curved or appressed hairs, eglandular save for sessile glands or occasional capitate glands on the calyces.

E. Nutlets finely granulose, the protuberances rounded; corolla tubes hairy within below the stamens but not sharply annulate; leaves oval, tending to oblong..26. **S. Wrightii**

EE. Nutlets tessellate, having the appearance of a mosaic; corolla tubes generally broadly annulate near the mouth of the calyx; leaves ovate ....27. **S. tessellata**

DD. Pubescence spreading, sometimes somewhat retrorse but not decurved or curled; calyces usually with capitate glands.

E. Corolla tube and galea 5–11 mm. long, glabrate within below the stamens, the lower stamens attached 2.5–4 mm. above the base of the tube; stems thinly pubescent with soft, spreading glandular hairs..34. **S. microphylla**

EE. Corolla tube and galea 8–22 mm. long, pilose within below the stamens, even annulate, the lower stamens attached 4–10 mm. above the base of the tube.

F. Pubescence of dense, minute, spreading, conical hairs; leaves oval, tending to rotund; lower stamens attached 7–10 mm. above the base of the tube, the galea and tube averaging about 18.5 mm. in length ....25. **S. resinosa**

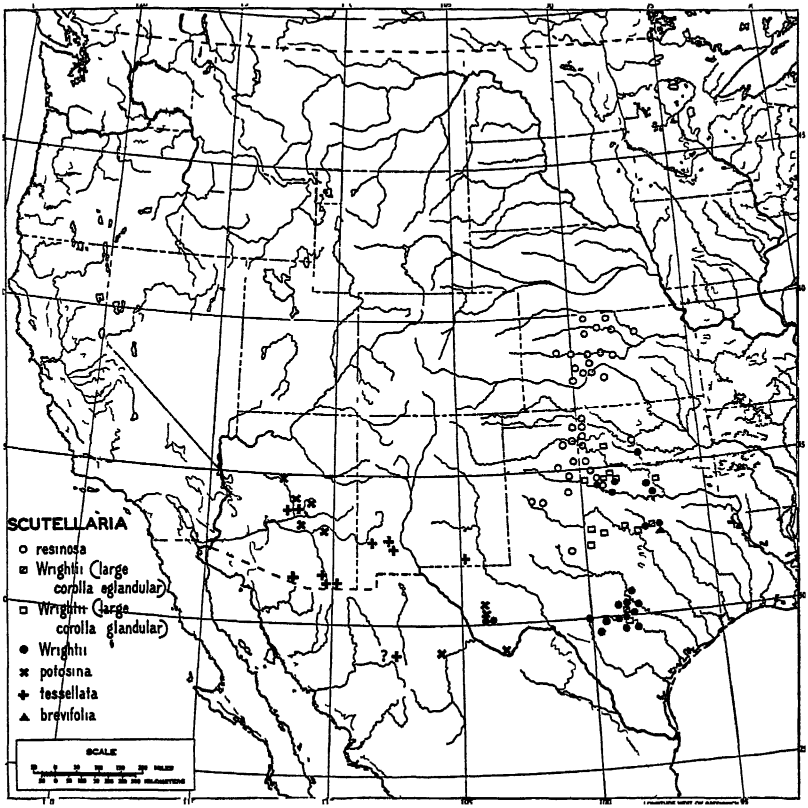
FF. Pubescence of spreading, often capitate, hairs and finer retrorse hairs, or with fine, somewhat retrorse hairs only, the longer hairs often as long as the thickness of the stem; leaves ovate; lower stamens attached 4–8 mm. above the base of the tube, the galea and tube rarely 18 mm. in length....................28. **S. potosina**

25. **S. resinosa** Torr., Ann. Lyc. N. Y. 2: 232, 1828; type collected by James on the Canadian River (N. Y. Bot. Gard.).

A low perennial commonly about 15–20 cm. tall, often with numerous stems arising in a tuft from a usually massive, woody, often-branched crown; pubescence of the stems of *minute, conical, spreading hairs,* rarely somewhat retrorse, or if ascendent usually so only on the leaves, usually somewhat glandular with larger sessile resin dots, rarely with capitate glands except on the calyces; leaf blades oval, *tending to rotund,* the median mostly 8–16 mm. long, 4.5–12 mm. wide, rounded at the apex, narrowed toward the base to petioles .5–2.5 mm. long; calyces resinous with sessile glands and with spreading minute hairs, *some of these usually capitate-glandular,* the lower lip 3.5–5 mm. long at anthesis, somewhat longer at maturity, the scutellum about 4 mm. tall, but broader and flaring; corolla deep violet-blue, the tube and galea *17–22 mm.* long, averaging about *18.5 mm.,* the lower stamens attached 7–10 mm. above the base of the tube, the galea pilose within on both sides, the tube pilose within, especially above the base, the lip glabrous or sparingly pilose in two lines or patches; nutlets black, *minutely, evenly, and closely tuberculate.*

This species occurs in the panhandle of Texas, in adjacent Oklahoma, and northward through central Kansas. In Kansas, at least, the pubescence is constant and distinctive. The corolla is relatively constant in size. See discussion under *S. Wrightii* (see also plate 2).

Distribution (see map 14).—ARIZONA. (?) Pima: *Pringle* in 1884. KANSAS. Clay, Ellis: *Shepherd* 99; *Rydberg and Imler* 1239; *Gates* 17959; Ellsworth, Gove, Hodgeman, Jewell, Mitchell, Ness, Osborne: *Shear* 72, 82; Pawnee, Phillips: *Oyster* 6731; Rooks, Rush, Russell: *Hitchcock* 410; Trego: *Gates* 16667; Wallace. OKLAHOMA. Beckham: *Demaree* 12452; Comanche, Ellis: *Goodman* 2595; *Clifton* 3025; Greer, Harper: *Demaree* 12390; Jackson: *Demaree* 12140; Oklahoma, Roger Mills: *Goodman* 2613; Tillman: *Demaree* 12192; Woodward. TEXAS. Armstrong, Childress, Crosby, Hall: *Reverchon* in 1904; Hemphill: *Palmer* 14117; *Eggert* in 1901; Lipscomb, Lubbock, Motley, Nolan: *Palmer* 13738; Roberts, Travis: *Hall* 456; Wheeler: *Parks and Cory* 16147.


SCUTELLARIA
○ resinosa
⊡ Wrightii (large corolla eglandular)
□ Wrightii (large corolla glandular)
● Wrightii
✖ potosina
✚ tessellata
▲ brevifolia
SCALE

Map 14. Distribution of *S. resinosa*, *Wrightii* (including *brevifolia*), *potosina*, and *tessellata*. The two latter are shown here only as they occur in the United States.

26. **S. Wrightii** Gray, Proc. Am. Acad. 8: 370, 1872, based upon specimens collected in Texas by Wright (477, 478, and 1539), by Lindheimer, and by Gordon; the choice of a type must be purely arbitrary, for each of the three Wright specimens in the Gray Herbarium represents a different form; the first is that species herein described as *S. potosina*, the second is an annual, *S. microphylla*, while the third represents the species most commonly referred to in herbaria as *S. Wrightii*. Because of this, and because Gray grew that species from Wright's seeds, I consider the third (no. 1539) to be the standard; it was collected in Uvalde County near the Sabinal River. Lindheimer's plant, collected near Fredericksburg, is conspecific. Gordon's plant, collected on the Canadian River, is *S. resinosa*.

S. ?brevifolia Gray, Syn. Fl. 2: 380, 1878; type collected by E. Hall near Dallas (Gray Herb.).

S. integrifolia var. *brevifolia* Gray, *in* Hall, Fl. Tex. 17, 1873.

S. resinosa var. *brevifolia* Penland, Rhodora 26: 72, 1924.

A low perennial commonly about 15–20 cm. tall, usually with several stems arising from a woody, usually branched crown; pubescence *minute,* decurved and *appressed,* usually curved downward on the leaves, *eglandular* except for larger sessile resin dots, the calyces sometimes with a few capitate glands; leaf blades oval, *tending to oblong* rather than rotund, the median mostly 8.5–20 mm. long, 4.5–12.5 mm. broad, rounded at the apex, narrowed at the base to petioles .5–3 mm. long; calyces resinous with sessile glands and usually with decurved hairs, infrequently with spreading capitate glands, the lower lip 3.5–4.5 mm. long at anthesis, somewhat longer at maturity, the squama about 4 mm. tall, but broader and flaring; corolla deep violet-blue, the tube and galea 12–23 mm. long, the lower stamens attached 5–8.5 mm. (12 mm. in *S. brevifolia*) above the base of the tube, the galea pilose within especially above the base, the lip glabrous or sparingly pilose in two lines or patches; nutlets *black and minutely, evenly, and closely tuberculate.*

The pubescence of *S. Wrightii* is distinctive, constant for the greater part, and readily determined by inspection with a lens. The habit of the plants, while less distinctive, is nevertheless recognizable, although confluent with that of *S. resinosa.* In the corolla, however, the variation is unusually large and complicates formal classification. The range in length is 12–23 mm.; the point of attachment of the lower stamens is 5–8.5 mm. (12 mm. if *S. brevifolia* is included). The evidence suggests a bimodal distribution, in which the average length of galea and tube for typical *S. Wrightii,* which is concentrated in south central Texas, is about 14 mm., the lower stamens being attached an average of 5.5 mm. above the base of the tube. The corresponding averages for a larger-flowered form which is not very different in flower size from *S. resinosa,* are 18.5 mm. and 8.5 mm. This form occurs in northern Texas and adjacent Oklahoma, a territory intermediate with that of *S. resinosa.* These averages are based upon measurement of a total of only 40 collections and the bimodal distribution may be only apparent. Capitate glands usually appear upon the calyces of this larger-flowered form, as in *S. resinosa.* Despite the larger flowers, these specimens can be recognized as *S. Wrightii* by the pubescence and habit. Only in a single collection (Sayre, Oklahoma *Demaree* 12470) are the specimens indeterminate, some having the pubescence of *S. resinosa,* some of *S. Wrightii,* but otherwise being indistinguishable.

Because of the nature of variation in these two categories and the distribution of the variants, I prefer to "maintain" both as species until more is learned of their interactions, partly on the supposition that the larger-flowered forms of *S. Wrightii* may represent a polyploid derivative. The situation is further complicated by *S. brevifolia,* a little known form of Dallas and Tarrant counties. In habit and pubescence this supposed species is scarcely distinguishable from *S. Wrightii,* although somewhat larger. Its corolla is 21–22 mm. long, however, and the point of attachment of the stamens is 12 mm. above the base of the tube. Inasmuch as it is known from only three collections, I have provisionally assigned it to *S. Wrightii.*

Distribution (see map 14).—OKLAHOMA. Carter, Cleveland, Comanche, Jackson, Murray *Demaree* 12276; *Emig* 776. TEXAS. Bexar: *Jones* 28541; Blanco, Brewster (glands on calyx), Burnet: *Palmer* 1087; Comal, Dallas: *Reverchon* 771; Eastland, Edwards, Gillespie, Hays, Kendall: *Palmer* 1086; *Parks and Cory* 12943; Kerr: *Palmer* 9960; *Heller* 1606, 3343; Presidio (glands on calyx), Tarrant, Travis, Uvalde, Wichita, Wilson.

Distribution of the larger-flowered form in which the calyces are usually capitate-glandular: OKLAHOMA. Beckham, Comanche, Custer, Ellis, Kiowa, Murray, Washita: *Stevens* 976. TEXAS. Blanco, Comal, Comanche, Erath, Hood: *Eggert* in 1900; Mills, Parker, Tarrant, Taylor.

Distribution of *S. brevifolia* (eglandular): TEXAS. Dallas: Dallas *Reverchon* 771; Fort Worth *Mrs. J. A. Stephenson* 25; Hutchins.

27. **S. tessellata** Epl. ex Kearney and Peebles, Jour. Wash. Acad. Sci. 29: 488, 1939; type collected by M. E. Jones (March, 1903) in the Huachuca Mountains, Arizona (U. S. Nat. Herb.).

A perennial herb generally 30–50 cm. tall, its stems few, ascending from a woody branching caudex, clothed throughout with *decurved but scarcely appressed hairs which are coarser than those of S. Wrightii, not at all glandular* unless with inconspicuous sessile glands; leaf blades *ovate*, the median 11–24 mm. long, 6–17 mm. broad, obtuse at the apex, cuneately narrowed at the base, even truncate, hirtellous with spreading or decurved hairs; petioles 1–6 mm. long; calyces sprinkled with inconspicuous sessile glands and short spreading or decurved sometimes glandular hairs, the lower lip 3–4.5 mm. long in flower, somewhat larger in fruit, the squama about 4.5 mm. tall; corolla violet, its galea and tube 12.5–19 mm. long, the galea sparingly pilose within, the tube *pilose-annulate near the mouth of the calyx;* stamens seated 4–8 mm. above the base of the tube, the lower lip sparingly pilose, nutlets fuscous (larger than those of *S. Wrightii* or *resinosa*), *tessellate*, the protuberances flattened, giving the appearance of a mosaic.

This species is distinguishable from *S. resinosa* and *S. Wrightii* by the taller and more diffuse habit, the coarser pubescence, the ovate leaves, usually distinctly petioled, and the hairy annulus in the corolla tube. The nutlets are larger and the protuberances are flattened, somewhat as in *S. canescens*. It is readily distinguished from *S. potosina* by the small decurved hairs. I have seen no mature nutlets in the New Mexico specimens referred here. The annulus does not appear so well defined in these specimens, nor are the leaves as large and ovate as in the Arizona forms, which are quite constant.

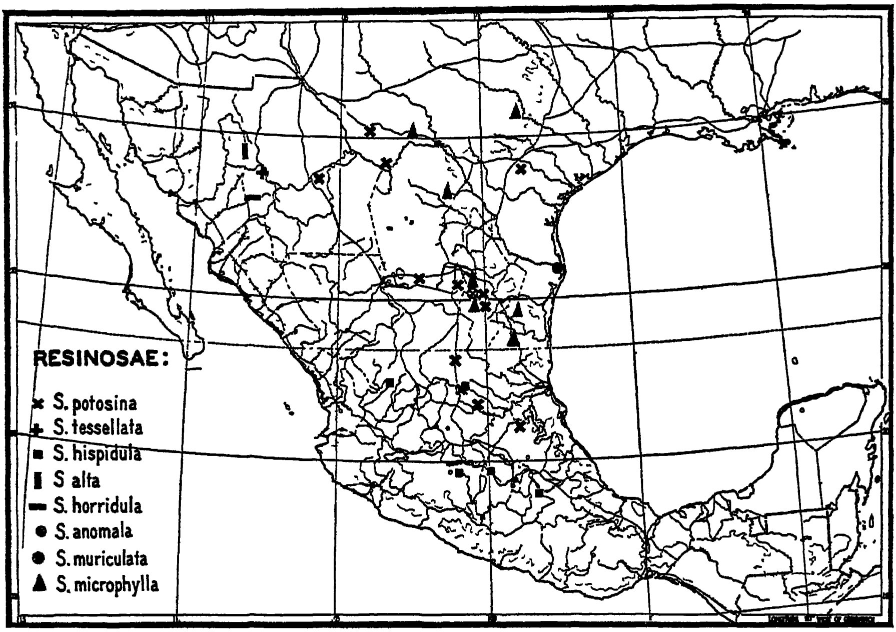
Distribution (see maps 14, 15).—MEXICO. CHIHUAHUA. Culebra Mountains *Le Sueur* 885; Guerrero: Rancho Colorado *Mexia* 2572; Cusihuiriachic, 17 miles north of Rubio. SONORA. Cañon Pulpito, Mun. de Agua Prieta *C. H. Muller* 3722.

ARIZONA. Cochise: Mule Mountains *Goodding* 991; Huachuca Mountains *Goodding* 224, 273, 796, 848; *Griffiths* 4809; *Lemon* 2860; Maricopa: Verde River, Mazatzal Mountains *Nelson* 1988; Pima: Baboquivari mountains *Kearney and Peebles* 10426; *Peebles, Harrison and Kearney* 392, 2768; Mustang Mountains *Pringle* in 1884; Santa Cruz: Pena Blanca Mountains; Yavapai: Ashfork *Toumey* 385. NEW MEXICO. Eddy: Guadalupe Mountains; Grant: Dog Spring *Mcarns* 100, 301; Lincoln: Alamo Forest *Chapline* 460; Sierra: Kingston *Metcalfe* 934.

28. **S. potosina** Brandegee, Univ. Calif. Publ. Bot. 4: 187, 1911; type collected by Purpus (no. 4874) at the Minas de San Rafael, San Luis Potosi, Mexico (Univ. Calif., Berk.).

A perennial herb commonly 20–30 cm. tall, usually with several stems arising from a woody, usually branched crown; pubescence usually of two sorts, formed of *a smaller hair which is usually somewhat retrorse and a longer capitate-glandular hair which is usually spreading* or somewhat retrorse, the latter sometimes absent, the pubescence of the leaves similar and mostly spreading; leaf blades *ovate*, quite variable in size, the median 7–8 mm. long or as much as 20–25 mm. long, rounded at the apex, narrowed at the base to petioles 2–3 mm. long; calyces resinous with sessile glands and thinly clothed with spreading often capitate-glandular hairs, the lower lip 3–4 mm. long at anthesis, enlarging somewhat at maturity, the squama about 4 mm. tall, but broader and flaring; corolla deep violet-blue, the tube and galea 8–19 mm. long, the stamens attached 4–7.5 mm. above the base of the tube, the galea pilose within on both sides, the tube pilose within *toward the base, even subannulate*, the lip glabrous or sparingly pilose in two lines or patches; nutlets black, *evenly and closely tuberculate* but more coarsely than those of *S. resinosa, S. Wrightii* or *S. microphylla.*

The specimens which I have referred to this species were referred by Leonard largely to *S. Drummondii,* an annual. Both species are similar in pubescence, and although I have seen two specimens of *Drummondii* that were perennial—or at any rate presented two periods of growth, I believe that there are important differences which are correlated with spatial distribution.



Map 15. Distribution of section *Resinosae* in Mexico.

The conformation of the corolla, difficult to put into words, is different and constant, particularly in the lower lip, the proportions of tube and galea, and the pubescence within the tube. Furthermore, the nutlets are readily separable, those of *S. Drummondii* being readily distinguished by their imbricated squamellae. Some specimens, particularly those of the Chisos Mountains, may be confused with *S. microphylla,* which is similar in pubescence. However, the absence of the finer retrorse hairs, the annual habit, and the glabrate corolla tube distinguish *S. microphylla.* As may be expected within so wide and diverse a range, much variation exists and, indeed, is apparently correlated with spatial distribution. While the material available is inadequate, it is indicative, and I am accordingly describing these forms as subspecies.

28*a.* subsp. **platyphylla** subsp. nov.; type collected by Harrison (no. 7778) in Fish Creek Canyon, Maricopa County, Arizona (U. S. Nat. Herb.).

Plantae 30–40 cm. altae et ultra caulibus valde extenso-hirsutis; foliorum mediorum laminis saepius 10–20 mm. longis; corollarum tubo (intus subannulato) et galea 14–19 mm. longo; staminibus inferioribus supra tubi basim 4.5–8 mm. positis.

The average observed length of galea and tube of 12 corollas was 15.6, the stamens being 5.6 mm. above the base of the tube. The Texas specimens referred here vary from the next subspecies in habit, yet some specimens are scarcely distinguishable from those of Arizona. The small secondary hairs are least conspicuous in the Arizona material. The three collections by E. J. Palmer are without corollas but are doubtless referable here. An anomalous form collected in Arizona south of Ashfork has pubescence like that of *S. resinosa,* but glandular. A specimen collected in the White Mountains, Arizona, by W. L. Shraeder (Boyce Thompson Arb.) has flowers with galea and tube 11 mm. long, the stamens attached 4.5 mm. above the base.

Distribution (see map 14).—ARIZONA. Cochise: Mescal Mountains *M. E. Jones* in 1890; Gila: Natanes Plateau *Goodding* 1086; Collom Camp, Mazatzal Mountains *Collom* 10; Parker Creek Ranger Station, Sierra Ancha *Peebles and Smith* 13257; Maricopa: hills above Verde River above Fort McDowell *Harrison* 1949; road to Amethyst Mine, Mazatzal Mountains *Eastwood* 17079; Salt River *Smart* 255; Pinal: Boyce Thompson Arboretum, Superior *Kearney and Peebles* 9176. ?NEW MEXICO. Without locality *Wright* 477. TEXAS. Atascosa: ?Pleasanton *E. J. Palmer* 9780; Jeff Davis: Davis Mountains *E. J. Palmer* 30738, 30899, 30964; Limpia Canyon *Earle and Tracy* 231; *Tracy and Earle* 340, 344; pine woods between Bob Manning and Little Ajuga canyons *Moore and Steyermark* 3139; Madera Springs *M. E. Jones* 48540; north of Marfa *Ingram* 2714.

28*b*. subsp. **parviflora** subsp. nov.; type collected by Moore and Steyermark (no. 3231) in the Chisos Mountains, Texas (Univ. Calif., L. A.).

Plantae saepius 15–30 cm. altae caulibus extenso-hirsutis; foliorum mediorum laminis saepius 8–12 mm. longis; corollarum tubo et galea 8–12 mm. longo; staminibus inferioribus supra tubi basim 3.5–4.5 mm. positis.

The average length of galea and tube of nine corollas was 10 mm., the stamens being 4 mm. above the base of the tube.

Distribution (see maps 14, 15).—TEXAS. Brewster: Blue Creek, Chisos Mountains *Moore and Steyermark* 3231; Chisos Mountains *Muller* 8148; Green Gulch, Chisos Mountains *Sperry* 357; Juniper Canyon, Chisos Mountains *Moore and Steyermark* 3231; Nail place *M. S. Young* in 1915.

MEXICO. CHIHUAHUA. Santa Eulalia Mountains *Pringle* 166, 850; Colonia Juarez *M. E. Jones* in 1903.

28*c*. subsp. **potosina** subsp. nov.; the type is that of the species (Univ. Calif., Berk.).

Plantae saepius 15–30 cm. altae caulibus sparse extenso-hirsutis; foliorum mediorum laminis saepius 8–12 mm. longis; corollarum tubo et galea 11–18 longo; staminibus inferioribus supra tubi basim 4–7.5 mm. positis.

The average length of galea and tube of 11 corollas was 14 mm., the stamens being 5.7 mm. above the base of the tube. The type specimen is least typical of any of the specimens referred here in the nature of the pubescence, the spreading glandular hairs being only sparsely represented. This subspecies is less hirsute than the other two. The variation in corolla size is similar to that of subsp. *platyphylla.*

Distribution (see map 15).—MEXICO. COAHUILA. Buena Vista *Gregg* 62, 746; Saltillo *Gregg* 122; ?Saltillo *E. Palmer* 280, 1084, 1085; San Lorenzo Canyon near Saltillo *E. Palmer* 546; Sierra de Parras *Purpus* 4591. HIDALGO. between Jacala and Tamazunchale *Rowntree* 332. NUEVO LEON. Chipinque, southwest of Monterrey *Pennell* 17258; Las Cañoas, Galeana *Muller* 2194; Montemorelos *Nelson* 6694; Tarry, Pablillo, SE. of Galeana *Pennell*

17043; San Francisco Cañon, 15 miles southwest of Galeana *Muller* 271. SAN LUIS POTOSI. Bagre, Minas de San Rafael *Purpus* 4874, 5294; Charcas *Lundell* 5029, 5054; San Luis Potosi *Schaffner* 342; San Miguelito *Schaffner* 642. TAMAULIPAS. Jaumave *Viereck* 614.

29. **S. anomala** sp. nov.; type collected by C. H. Mueller (no. 2154) in the Sierra de la Cebolla between Potrero Redondo and Casillas, Nuevo Leon, Mexico (Univ. Calif., L. A.).

Herba verisimiliter perennis altitudine circiter 20 cm. caulibus pauciramosis utrimque *pilis incurvis dense villosis;* foliorum laminis (habitu *S. Brittonii*) ovatis 2–2.5 cm. longis elatis; floribus supra medium in foliorum axillis dispositis; calycibus extus villosis et sparse capitato-glandulosis circiter 4 mm. longis; corollarum violacearum galea et tubo *18 mm.* longo, intus praesertim infra medium piloso; staminibus supra tubi basim 7 mm. positis; nuculis non visis.

Distribution (see map 14).—Known only from the specimen described.

30. **S. alta** M. E. Jones, Contrib. to West. Bot. 12: 70, 1908; type collected by Jones in Guayanopa Cañon, Chihuahua, Mexico (Pom. Coll.).

A perennial herb 50–60 cm. or more tall with several or numerous stems arising from a woody caudex, pubescent with spreading hairs in the lowest parts, elsewhere with small *upwardly* curled and mostly appressed hairs; leaf blades *deltoid*-ovate, mostly 1.5–3 cm. long, the lowermost crenate-serrate, on petioles *8–10 mm.* long, the upper mostly entire, on petioles 2–3 mm. long, both surfaces equally puberulent with small upcurled hairs; flowers axillary in the upper half of the plant; flowering calyx hirtellous, not at all glandular, its lower lip 3 mm. long at anthesis, 4.5 mm. at maturity, the squama then 3 mm. tall; corolla blue, its galea and tube 12 mm. long, the tube densely pilose near the mouth of the calyx, somewhat annulate; nutlets black, finely muriculate.

Distribution (see map 15).—Known only from the specimen described.

31. **S. hispidula** Robinson, Proc. Am. Acad. 26: 174, 1891; type collected by Pringle (no. 3233) in meadows near Flor de Maria, Mexico (Gray Herb.).

A perennial herb with several stems arising from a usually woody crown, commonly 20–30 cm. tall, thinly hispidulous with stout but small ascendent hairs; leaves oval or ovate, *subsessile,* the median commonly about 1 cm. long, their margins entire or subserrate, both surfaces green, thinly hispidulous; flowers axillary in the upper half of the plant; flowering calyces hispidulous, not glandular, the lower lip 4 mm. long at anthesis, about 5 mm. at maturity, the squama then about 3 mm. tall; corolla violet, its tube and galea 10.5–12.5 mm. long, both usually glabrous within, the lip with two thin patches of hairs; lower stamens seated 5–6 mm. above the base of the tube; nutlets black, finely granulose.

Distribution (see map 15).—MEXICO. SAN LUIS POTOSI. Sierra de Alvarez *Pennell* 17767. PUEBLA. San Francisco, near Puebla *Fr. Arsene and Nicolas* 221. MEXICO. Flor de Maria *Pringle* 3233, 5229. JALISCO. Morelia, in the Cerro Azul *Fr. Arsene* in 1911; Huejuquilla *Rose* 2555. COAHUILA. Puerto de San Lazaro, Sierra de San Lazaro, Mun. de Castaños *Muller* 3081.

32. **S. horridula** sp. nov.; type collected by Gentry (no. 2570) on the Rio Mayo, Chihuahua, Mexico (Univ. Calif., L. A.).

Herba perennis altitudine circiter 30 cm. caulibus ut videtur e caudice lignoso utrimque *pilis extensis crassiusculis sparse pilosis;* foliorum laminis ovatis mediis circiter 15 mm. longis subserratis pilis minoribus sparse pilosis petiolis 1–2 mm. longis elatis; calycum florentium pilosorum labia inferiore 4.5 mm. longa, in maturitate paulo aucta, squama 3 mm. alta; corollarum violacearum tubo et galea 12 mm. longo, intus *fere glabro, labia* inferiore in lineas duas pilosa; staminibus inferioribus 6 mm. supra tubi basim positis; nuculis *fuscis paxillatis horridulis.*

Distribution (see map 15).—Known only from the specimen described.

33. **S. Drummondii** Benth., Lab. Gen. et Sp. 441, 1834; type collected by Drummond along the Rio Brazos, Texas (Kew).

S. Helleri Small, Man. Fl. SE. U. S. 1024, 1903; type collected by Heller (no. 1503) near Corpus Christi, Texas (N. Y. Bot. Gard.).

An *annual* herb commonly 20–30 cm. tall, branching at the base when well developed, the branches commonly procumbent at the base, clothed throughout with slender soft *spreading* more or less glandular hairs, some retrorse, or sometimes, especially in the lower parts, clothed by retrorse finer hairs; basal leaf blades ovate, commonly 1–2 cm. long on slender subequal petioles, subcrenate, the median similar but on shorter petioles, commonly entire, the uppermost diminished, subsessile and usually entire, all clothed like the stems; flowering calyces pilose and more or less glandular, the lower lip 3–5.5 mm. long, somewhat longer at maturity, the squama then about 3 mm. tall; corolla violet, its tube and galea 5–15 mm. long, averaging 9–10 mm., the lower lip glabrous or with two patches of hairs, the throat pilose, *the tube glabrous or nearly so below the point of attachment of the stamens;* lower stamen seated 2.5–6.5 mm. above the base of the tube, averaging about 4 mm.; nutlets fuscous or black, *covered with more or less imbricated lamellae.*

Variability in the corolla size comparable to that of *S. Wrightii* exists in *S. Drummondii.* Though there is also some suggestion of a bimodal distribution, measurements made from the corollas of 77 collections are inconclusive. A plot of the spatial distribution of the forms (with a corolla length of 10 mm. the division point) shows that they both occur throughout the greater part of the whole range, neither concentrated in any one area.

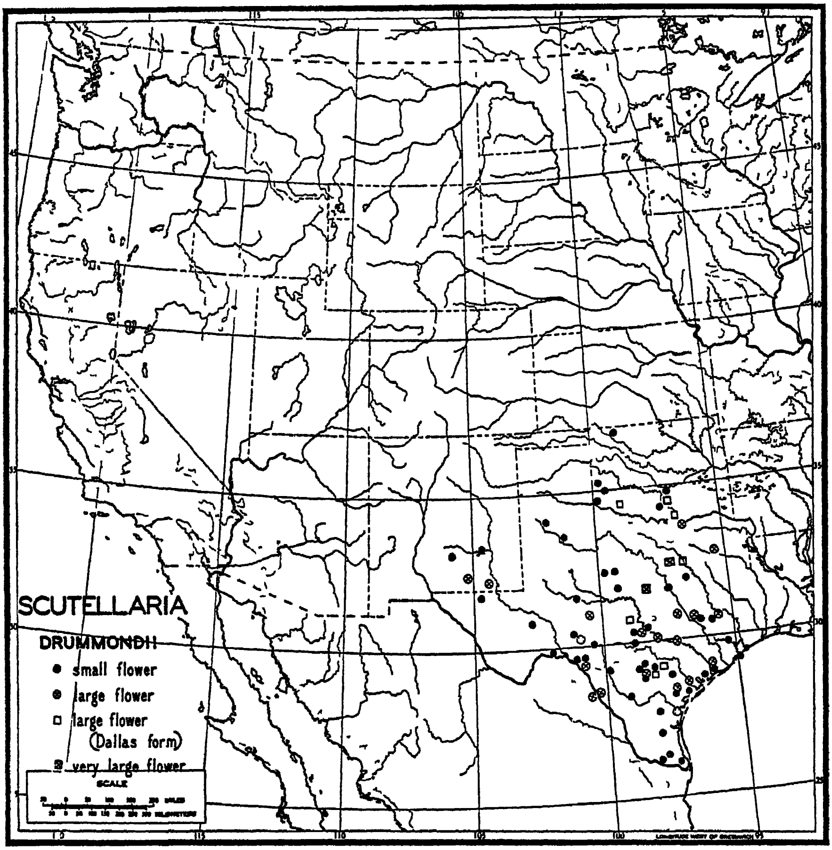
A second manner of variation is found, particularly in the lower part of the stem, in the finer retrorse hairs in addition to those that spread. This "Dallas" form is usually associated with the larger-flowered forms, but seems to occur chiefly in Llano, Tarrant, and Dallas counties, Texas, and in Marshall, Comanche, and Murray counties, Oklahoma. A third form has been collected in Tarrant and Comanche counties, Texas (*Ruth* 111, 588; *Eggert* in 1900). In this the galea and tube are 14 and 15 mm. long, the lower stamens being attached 5.5–6.5 mm. above the base of the tube. The average length of 77 corollas was 9 mm.; the lower stamens were seated 4 mm. above the base. This "Dallas" form, therefore, bears the same relation to this species that *S. brevifolia* bears to *S. Wrightii.*

Distribution (see maps 15, 16).—NEW MEXICO. Chaves: Roswell *Earle* 556; *Earle and Earle* 269; Eddy: Carlsbad Cavern, Guadalupe Mountains; Otero: Sacramento Mountains. OKLAHOMA. Marshall, Comanche, Harmon: *Stevens* 1078; Murray: *Goodman* 2458; Pontotoc, Woods: *Stevens* 695. TEXAS. Austin, Baird, Bandera, Bastrop: *Palmer* 33368; Bee, Bell, Bexar, Blanco, Brazos, Cameron, Childress, Coleman, Comal, Dallas: *Bush* 627; *Hall* 457; *Reverchon* 772, 2065, 2124, 2125; Dickens, Duval, Edwards, Encino, Fayette, Floyd, Galveston, Gillespie, Goliad, Grayson: *Palmer* 2042; Harris, Hays, Hidalgo, Kerr: *Heller* 1613, 10923; Kimble, Kinney, Lasalle: *Palmer* 11303; Llano, Matagorda, McLennan, Medina, Milam, Montgomery, Navarro, Nueces: *Heller* 1503, 14135; Pecos, Refugio, Sutton, Tarrant, Taylor, Tom Green, Travis, Uvalde, Val Verde, Victoria, Walker, Willacy, Wood.

MEXICO. COAHUILA. 12–14 leagues south of Saltillo *Palmer* 1085; gravelly mesas near Diaz *Pringle* 9003; CHIHUAHUA. Santa Eulalia Mountains *Pringle* 166. NUEVO LEON. Near Monterrey *Mueller and Mueller* 151, 152. SAN LUIS POTOSI. Charcas *Lundell* 5758.

34. **S. microphylla** Moc. et Sessé ex Benth, *in* Lindl. Bot. Reg. 18, pl. 1493, 1832 (not of Leonard), based upon a plant collected by Mociño and Sessé in Mexico; authentic material in Madrid Herb.

An erect perennial or sometimes annual, as much as 40 cm. tall, more or less branched throughout, *softly pilose throughout with slender, spreading glandular hairs;* basal leaf blades ovate, commonly 1–1.5 cm. long, on slender petioles about half as long, subcrenate, the median similar but on shorter petioles, entire or subcrenate, the upper diminished, often scarcely 5 mm. long, subsessile and usually entire, all clothed like the stems; flowering calyces glandular-pilose, the lower lip 2–3 mm. long, somewhat longer at maturity, the squama then about 2.5–3 mm. tall; corolla violet, its tube and galea 5–11 mm. long, the lower lip glabrous or with two small patches of hairs, the throat pilose, *the tube nearly glabrous below the lower stamens;* lower stamens seated 2.5–4 mm. above the base of the tube; nutlets *black, finely granulose.*



Map 16. Distribution of *S. Drummondii* in the United States.

This species, in the absence of nutlets, is hard to distinguish from *S. Drummondii.* The habit is more slender and the plants are more inclined to branch above the base; the pubescence looks finer and softer. The species apparently occurs in Texas, but owing to the difficulty of finding mature nutlets in herbaria its range is not clear. *Wright* 1540 is assuredly this species. It is interesting to note that Gray grew plants at Cambridge from Wright's seeds and labeled the specimen "n. sp. near Drummondii." The species seems clearly to appear in part as an annual, in part as a perennial.

Distribution (see map 16).—TEXAS. "Valley of the Pecos" *Wright* 1540; "High Prairies of San Felipe" *Wright* 478; Lampasas: Rancho Resendez *M. T. Edwards* 350; Llano: Enchanted Rock *E. Whitehouse* 8761; Reeves: Pecos *Tharp* in 1931; Terrell: dry plains near Feodora *E. J. Palmer* 33502.

MEXICO. COAHUILA. Hacienda La Rosita, Muzquiz *Wynd and Muller* 373. NUEVO LEON. Canyon Denuncio, Rancho La Bolla, Villa Santiago *C. H. Muller* 2017, 2018; El Diente Canyon near Monterrey *Pennell* 16874; Las Ajuntas, Mun. de Villa Santiago *C. H. Muller* 2996. TAMAULIPAS. Cerro de Los Armadillas, San Jose, Sierra de San Carlos *Bartlett* 10199; Sierra near San Lucas, Jaumave *Rozynski* 544; Victoria *Runyon* 891.

35. **S. muriculata** sp. nov.; type collected by Runyon (2044) near Brownsville, Texas (Univ. Calif., L. A.).

Herba *annua* altitudine 20–30 cm., in basi ramosa et plus minusve procumbens caulibus utrimque pilis *parvis decurvis* cinereis; foliorum infimorum laminis ovatis vel deltoideo-ovatis plerumque 10–15 mm. longis, crenatis, petiolis ad 7–8 mm. longis elatis, superiorum subsessilibus subrotundis subintegris, omnium paginis ambabus pilis parvis curvis molliter hirtellis; calycibus florentibus pilis similibus hirtellis, labia inferiore in maturitate 3.5 mm. longa, squama 2 mm. alta; corollarum caerulearum tubo et galea 11.5 mm. longa, labia inferiore glabra maculata, *tubo intus ad staminum connexum subannulato;* staminibus inferioribus supra tubi basim 3 mm. positis; nuculis atro-fuscis utrimque *muriculatis.*

Distribution (see map 16).—TEXAS. Cameron: San Benito *Mrs. P. Cottrell;* Resaca Park on the west side of South Bridge *Runyon* 2044; El Jardin, Brownsville, near Club House *Runyon* 644; Calhoun: Port O'Connor *Tharp;* Willacy: North of Raymondsville *Lundell* 8749; Katharine *H. H. York.*

SECTION VI. Saxicolae

Plants with the xeric habit of *Resinosae,* with several stems arising from a woody caudex and linear-oblong leaves. The flowers, however, are like those of the section *Annulatae,* the corolla being characterized, apart from its conformation, by an oblique, well-defined, narrow annulus just above the calyx. The flowers are axillary. The nutlets are comparatively large, brown and verrucose; seemingly only one matures. The type and only species is *S. Bushii* Britton.

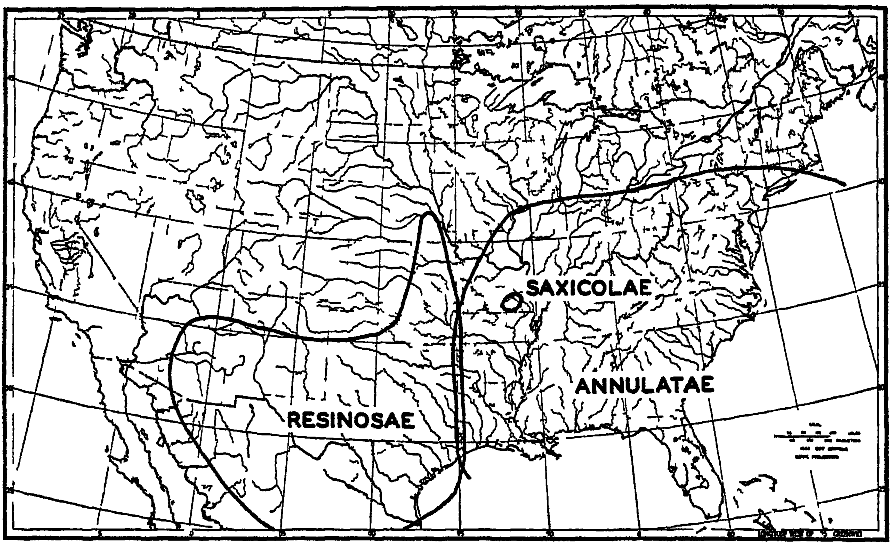
The single species of this section is restricted in area and has been seldom collected; the available material presents but little variation. In habit and pubescence the plants suggest *Resinosae* (see fig. 6), but have flowers like *Annulatae.* The nutlets are somewhat similar to those of the broad-leaved series of *Annulatae;* the foliage is similar to that of *Resinosae* or of the narrow-leaved series of *Annulatae.* As the species lies in intermediate territory, it may have been formed through intermixture of these two groups in time past, or it may represent an outlying xeric form of *Annulatae* which parallels *Resinosae* in habit.

36. **S. Bushii** Britton, Man. Fl. N. U. S. 785, 1901; type collected by Bush (no. 54) in Shannon County, Missouri (N. Y. Bot. Gard.).

A perennial herb commonly 30–40 cm. tall, with several stems arising from a woody caudex, puberulent throughout with short, upwardly curled hairs; leaves sessile, or nearly so, ascendent, usually longer than the corresponding internodes, linear-oblong, entire, commonly 2.5–3 cm. long, 5–8 mm. broad, obtuse, narrowed at the base; flowers borne in the upper half of the plant, in the axils of slightly diminished leaves; lower calyx lip 3.5–4.5 mm. long at anthesis, about 5 mm. long at maturity, the squama then 6–7 mm. tall;

galea and tube 23–26 mm. tall, the stamens seated 9–12 mm. above the base, the tube obliquely annulate just above the calyx, the palate glabrous; nutlets brown, verrucose, apparently solitary at maturity.

Distribution (see map 17).—MISSOURI. Carter: Van Buren *E. J. Palmer* 19496; Dent: Current River near Shannon County line *Steyermark* 19407; Douglas: Richville *Steyermark* 19145; Oregon: Eleven Points River, Greer *Steyermark* 12128; Ozark: Bald Jesse near Gainesville *E. J. Palmer* 34745; Double or Rainbow Spring near Dora *Steyermark* 15582; Pontiac *Kellogg* 25503; Tecumseh *E. J. Palmer* 33039, 34809; Pulaski: Waynesville *Steyermark* 19346; Shannon: rocky open woods and glades near Round Spring *Palmer and Steyermark* 41421; Montier *Bush* 48, 49, 54, 189, 378, 461, 4737, 7817.



Map 17. Distribution of *S. Bushii*, and sections *Resinosae* and *Annulatae*.

SECTION VII. Annulatae

Herbaceous plants often a meter tall or more, less often smaller, stems erect and sparsely branched except in the inflorescence, one or two arising from a short rootstock. Leaves diverse, from ovate or subrotund and more or less cordate to linear or filiform. Flowers in racemes or panicles, borne in the axils of leafless, entire, persistent, ovate bracts; upper lip of calyx produced into a thoroughly impressed transverse scutellum. Corolla blue-violet, the tube more or less geniculate at the orifice of the calyx and characterized by a sharply defined hairy annulus within the tube at that point; annulus oblique in the tube and vertical when the flower is in its position (*S. montana* is exannulate); corolla lip pilose or glabrous. Stamens seated near the middle of the tube. Nutlets generally dark brown, either coarsely verrucose, or covered with deflexed squamellae. The type species is *S. incana*.

In the northern and western range of the section the variability is slight and the specific lines are relatively clear. Toward the Gulf and South Atlantic states the complexities increase, owing apparently to present or past hybridization or both. Species are accordingly hard to distinguish. At least six, *S.*

floridana, glabriuscula, multiglandulosa, integrifolia, Altamaha, ovalifolia, occur in the restricted district of northwestern Florida. Until more comprehensive study is practicable, about the only course open to the systematist is to let his arrangement suggest the approximate position of the segregating factors.

The flowers of the fifteen species of this section are remarkably uniform in conformation, color, and especially in size; the extreme range in length of galea and tube is 14–35 mm.—nearly the same proportionately as in one species alone, *S. Wrightii* (12–22 mm.), and less than in *S. Drummondii* (5–15 mm.). If the three largest species be omitted, the remaining twelve have corollas whose range is 14–32 mm., a spread not much greater than expected within many well-defined species. The averages are even closer. This variation is illustrated in fig. 7.

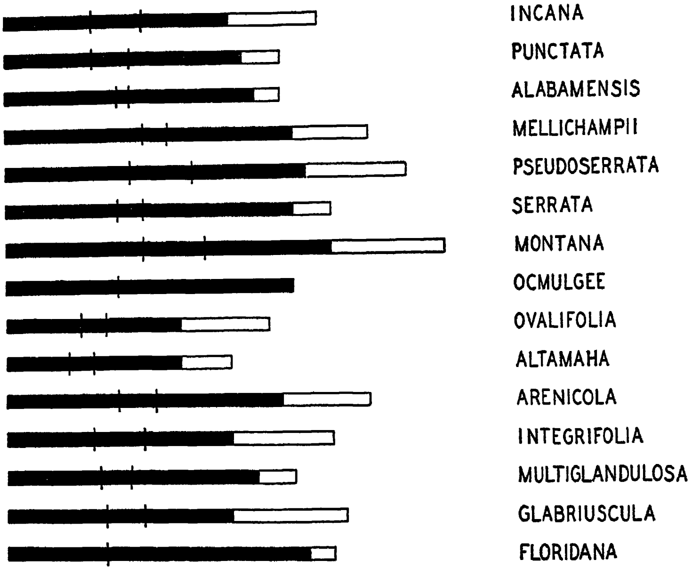


Fig. 7. Variation in the proportions of the corolla of section *Annulatae*. Maximum length of galea and tube is indicated by entire bar, minimum by shaded portion; transverse lines indicate maximum and minimum position of lower pair of stamens above base of tube. Only one specimen of *S. Ocmulgee* was available.

Mature nutlets are known to me from only seven species. These show two patterns: in one (*S. incana* and *S. punctata*) the nutlets are coarsely and closely verrucose, appearing almost tessellated above, more imbricated toward the base; in the second (*S. serrata, ovalifolia, integrifolia, multiglandulosa,* and *glabriuscula*) the nutlets are covered with thickish subimbricate squamellae. The nutlet pattern apparently coincides with a habit pattern. Species with the first pattern have generally ovate leaves. In species with the second pattern the leaves vary mostly from rhomboid to elliptical and linear, and the relationship to the internode is of a different order. An exception is *S. serrata.*

QUANTITATIVE CHARACTERISTICS OF SPECIES OF ANNULATAE

Species	Corolla length			Position of stamens			Leaf length			Leaf breadth			Petiole length		
	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.
S. incana	18	20.5	25	7	8.5	11	65	85	120	30	50	70	15	20	35
S. punctata	19	20.5	22	7	8.5	10	50	85	120	25	40	65	15	20	25
S. alabamensis	20	21	22	9	9.5	10	35	50	60	20	25	30	5	8	10
S. Mellichampii	23	25	29	11	12	13	70	75	95	35	45	55	15	..	30
S. pseudoserrata	24	28	32	10	12.5	15	60	65	75	30	35	45	5	10	15
S. serrata	23	24.5	26	9	10	11	45	75	120	25	30	45	10	17	25
S. montana	26	31	35	11	15	16	50	65	80	25	33	40	10	..	15
S. Ocmulgee	..	23	..	..	9	..	60	..	65	..	50	..	20	..	25
S. ovalifolia mollis	14	17	21	6	7	8	35	50	65	20	28	45	5	9.5	18
S. ovalifolia hirsuta	..	..	..	..	..	..	30	45	65	15	30	60	5	12	18
S. Altamaha Altamaha	14	16	18	5	6	7	25	40	50	10	22	35	3	7	13
S. Altamaha australis	..	..	..	..	..	..	30	50	82	20	25	45	6	12	17
S. arenicola	22	25	29	9	11	12	20	30	45	8	16	45	2	8	14
S. integrifolia typica	8	23	26	7	8.5	11	20	35	60	5	10	15	2	5	10
S. integrifolia hispida	19	23	27	7	9	10	25	35	75	5	16	25	3	8	15
S. integrifolia hispida β	22	25	29	9	10	12	..	..	..	.	.	..	..	..	..
S. multiglandulosa	20	21	23	8	8.5	10	20	33	45	6	9	14	..	..	..
S. glabriuscula	18	23	27	8	9.5	11	20	33	50	3	7	14	5	..	6
S. floridana	24	25	26	..	8	..	20	..	40	1	..	2.5	..	..	..

Although the section *Annulatae* has much the same growth form and similar flowers, the variation in leaf form is unusually wide. *S. incana* leaves are cordate, as much as 12 cm. long and 7 cm. broad, borne on petioles averaging 2 cm. long. At the other end of the spectrum, the leaves of *S. floridana* are 2–4 cm. long, linear, and sessile. The nature of leaf variation is shown in fig. 8 and in the accompanying table. Pubescence is diverse, but is correlated with leaf shape and habit, and with geographical distribution.

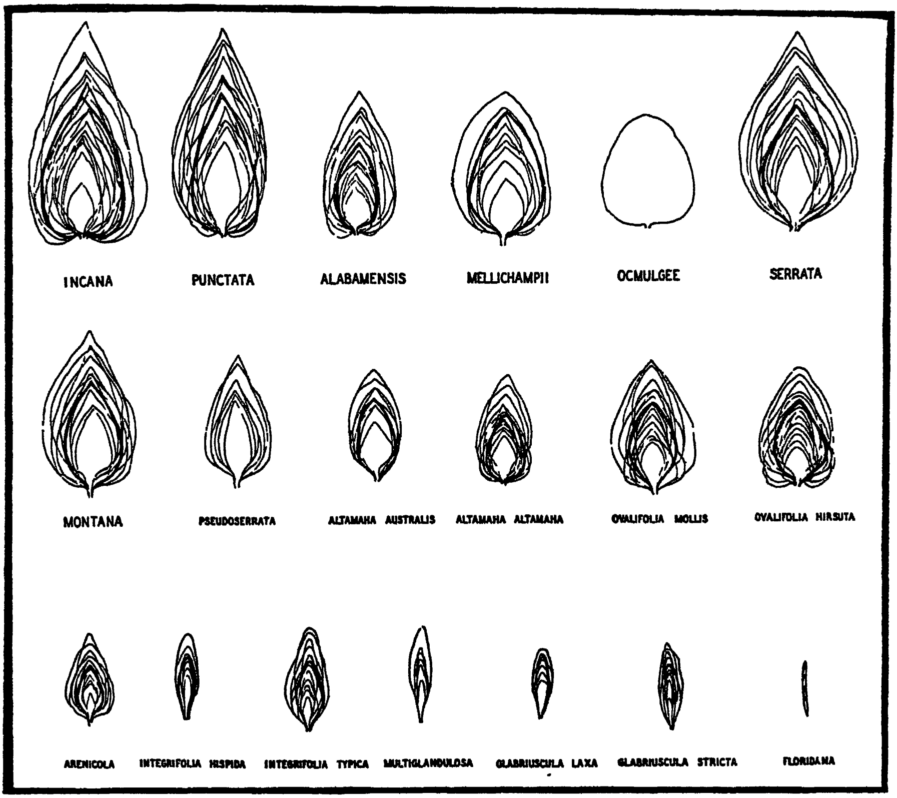


Fig. 8.—Leaf variation in section *Annulatae*. Tracings were made from a median leaf, usually the largest, of the herbarium specimens available. Measurements made upon the same leaves are summarized in accompanying table. Mean in size and shape is indicated by heavier lines.

It is chiefly upon leaf habit and pubescence that specific segregation is based. Within the fifteen species thus delimited there is an appreciable diversity. Several are known inadequately. There are at least four, however, in which subspecific variation can be discussed with some confidence, for the species are widespread and often collected.

S. incana, for example, ranges widely through the Ohio River Valley from Pennsylvania to Missouri. It is more abundantly collected on the northern slope of the basin rather than southern. In the Appalachian Mountains it does not occur south of West Virginia. Throughout this range it is fairly uniform in habit. The leaves are generally cordate in shape but may be notched only at the base. In pubescence, however, there is notable variation in the presence or absence of small capitate glands, which may appear at the base of the stem, or on the inflorescence and on the calyces, or in both places (as many of the plants lack the basal portions, the evidence is not complete). However, no geographical correlations appear to exist in the distribution of the glands. Excepting these glands, I have observed no readily recognized variants other than those that may be due to seasonal modifications.

Closely allied to *S. incana,* and differing chiefly in the sum of vegetative habit and pubescence, are two allied forms: *S. punctata,* which occurs in the mountains of Virginia, Tennessee, and North Carolina, and *S. alabamensis,* which occurs in the mountains of Alabama. *S. punctata* is fairly uniform, *S. alabamensis* less so; *S. punctata* seldom has the small capitate glands whereas *S. alabamensis* apparently has them constantly on the calyces and at the base. The mature nutlets of *S. alabamensis* are unknown to me, but since those of *S. punctata* scarcely differ from those of *S. incana,* some authors may prefer to consider these three forms as subspecific and coördinate. Their morphology suggests to me that they are specifically isolated. Since they are geographically segregated, this opinion can be proved only by experiment. All three may very well be the segregants of a former, variable species.

S. Mellichampii, an inadequately known form from South Carolina, suggests a previous connection with *S. alabamensis.* Two other dubious forms, *S. pseudoserrata* and *S. montana,* suggest a similar relationship. *S. Ocmulgee,* known from a single locality, suggests a hybrid form in which *S. ovata* (*Mixtae*) may have been involved. *S. serrata* is a species that, while remarkably uniform throughout and readily recognized, is nevertheless difficult to define in a formal sense. It ranges from Pennsylvania to South Carolina, chiefly in the Atlantic drainage.

The species thus far discussed constitute one shadowy alliance. The following constitute a second alliance within which the nutlets are similar, so far as known, but differ from those of the previous species in pattern. Some of these species may have been derived through hybridization of prototypes similar to the modes of both alliances.

S. ovalifolia and *S. integrifolia* may be considered together, for their subspecific patterns are remarkably alike. No constant characteristic defines them or clearly separates all the specimens. The bases of segregation are vegetative habit and a modal difference in flower size. Five other species (*S. Altamaha, S. arenicola, S. glabriuscula, S. multiglandulosa* and *S. floridana*) follow much the same pattern of variation. All suggest segregants from a polymorphic complex within the section.

S. ovalifolia ranges throughout the southeastern states from New York to Oklahoma and northern Florida. Three stations are also known in northern Indiana and southern Michigan. The principal variation lies in leaf form combined with pubescence. I have distinguished the geographical variants as subsp. *mollis* and subsp. *hirsuta.* The former (see plate 3) is characterized by leaves which tend to be oval, and lightly crenate, closely approaching those of *S. integrifolia* in habit. The pubescence of the stems is predominantly of soft, upwardly curled hairs on all faces, although in the lower parts the hairs are spreading or somewhat retrorse. Subsp. *hirsuta* is characterized by leaves which tend to be deltoid or rhomboid rather than oval, and usually coarsely crenate or toothed. The pubescence of the stems consists largely of spreading, straight, rather coarse hairs, especially in the lower parts. If curled hairs are present they are often coarser and are usually found on alternate faces of the stem.

The degree of intergradation, both in form and pubescence, suggests at least that in wide areas there is still some interchange of genes. I have accordingly preferred to class these forms as subspecies. Subsp. *hirsuta* occurs chiefly in the immediate valley of the Ohio and on the west slopes of the Appalachian Mountains. It does not occur on the east slopes. The stations in Michigan and Indiana are of this form. Throughout this range the subspecies is fairly constant and readily defined. Subsp. *mollis* occurs in characteristic form west of the Mississippi River in Missouri, Arkansas, Oklahoma, and Louisiana. It also occurs in the Atlantic drainage area from southern New York to northern Florida and southern Alabama, with a few stations in the Ohio Valley, chiefly in West Virginia. It is fairly uniform, but is frequently confused with forms that are apparently intermediate with subsp. *hirsuta.* Such enclavement is unusual in the Labiatae. The closely allied *S. Altamaha* occurs in the southern part of this range, sometimes in the same localities. Usually it replaces *S. ovalifolia.* There is some suggestion in *S. Altamaha* of intermixture with *S. punctata* or a similar form.

S. integrifolia has a range similar to *S. ovalifolia.* It is infrequent in the Ohio River Valley, however, and occurs throughout most of Florida. In this area two fairly well defined subspecies occur. Subsp. *typica* is characterized by a soft, upwardly curled pubescence on the stems, with short spreading hairs in the lowermost parts; the median leaves are usually entire and tend to be elliptical. In these respects it parallels subsp. *mollis* of *S. ovalifolia.* Subsp. *hispida* is hispid, at least in the lower parts, with spreading stiffish hairs, becoming curled in the upper parts; the leaves tend to be rhomboid, with the widest part nearer the base, are often crenate, and usually larger than in *typica.* Such plants parallel subsp. *hirsuta* of *S. ovalifolia.* Both subspecies, as in *S. ovalifolia,* usually have small capitate glands on the base of the stem and in the inflorescence.

The subspecies of *S. ovalifolia,* except when seemingly intermixed, are fairly uniform. The subspecies of *S. integrifolia,* however, appear to comprise two variant races. In subsp. *typica* the calyces and inflorescence may bear capitate glands. The evidence suggests that these glandular forms are being segregated geographically. In subsp. *hispida* the palate of the corolla may be glabrous or pilose, the glabrous form being wholly confined to Florida. The glabrous and hairy palate is repeated in a closely allied species, *S. glabriuscula,* which has two forms, geographically separated. Only the glabrous form occurs in Florida, the hairy form occurring in Alabama and Mississippi.

S. multiglandulosa is a species separable from *S. integrifolia* chiefly by pubescence and habit, particularly by the relation of the leaf length to the

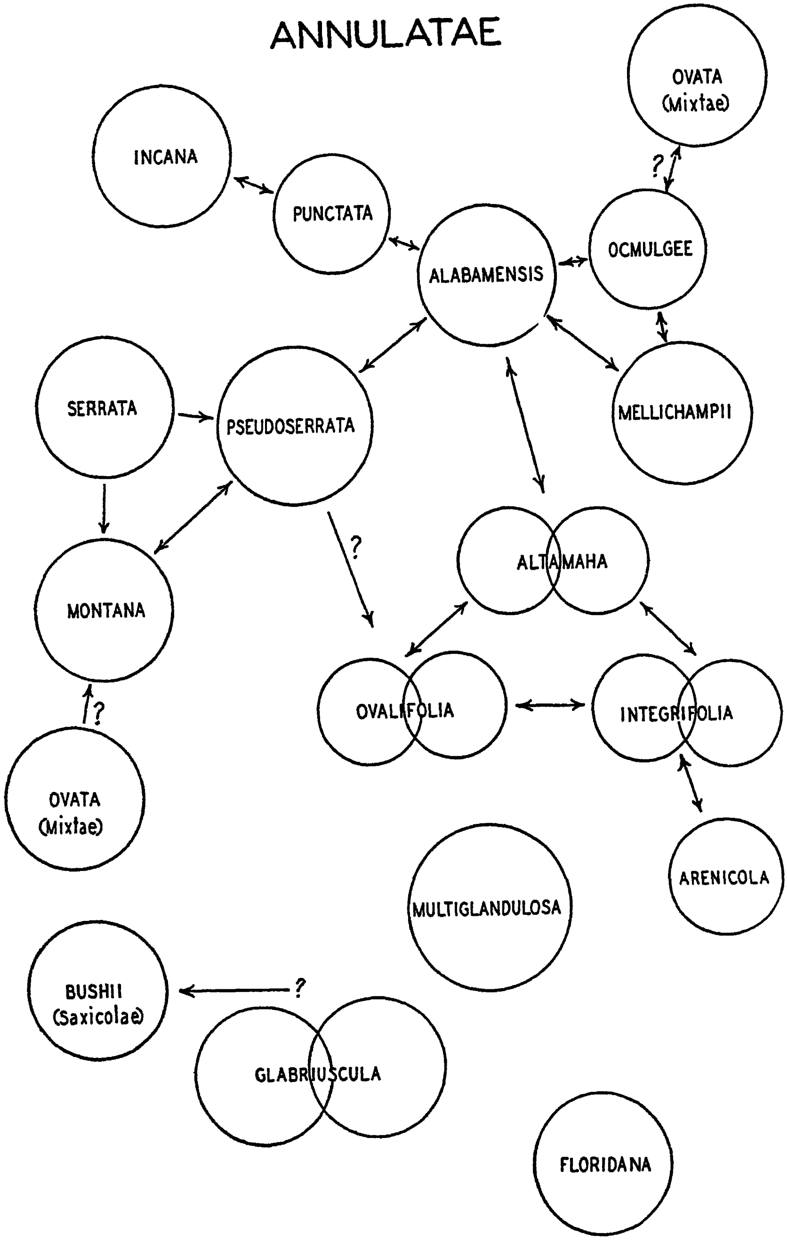


Fig. 9. Relationships within the section *Annulatae*, showing connections with sections *Mixtae* and *Saxicolae*.

internode. Constancy in pubescence and leaf texture clearly segregates the species. It apparently occurs in two disjunct areas, in Georgia and in northern Florida. It is nevertheless stable, there being no perceptible difference between the plants in the two areas. *S. Altamaha* occupies almost the same areas; in this species, however, two fairly well defined races have emerged, one to each area. The relationships suggested above are shown in fig. 9.

KEY TO THE SPECIES

A. Median leaves entire or nearly so.

B. Median leaves linear, 1.5–2.5 mm. wide; plant glabrous..........51. **S. floridana**

BB. Median leaves elliptical, rarely rhomboid, rarely as little as 3 mm. wide.

C. Plants glabrate, except for a few spreading hairs in the lowermost parts, the stems and calyces thinly clothed with small, appressed, upwardly curled hairs, sometimes with a few spreading capitate glands....50. **S. glabriuscula**

CC. Plants clearly and variously pubescent.

D. Median leaves nearly sessile, rarely subequal to the internodes they subtend, usually longer, averaging 33–34 mm. against 22–23 mm. for the internodes..................................49. **S. multiglandulosa**

DD. Median leaves generally petioled, the petioles 2–17 mm. long, averaging about 5–8 mm. long, the blades rarely equal to the internodes they subtend, usually much less, rarely longer, averaging 32–38 mm. against 48–52 mm. for the internodes.....................48. **S. integrifolia**

AA. Median leaves crenate-serrate (see also forms of *S. integrifolia*).

B. Galea and tube of the corolla 14–21 mm. over all, averaging about 16–17 mm., the lower pair of stamens attached 5–8 mm. above the base, averaging 6–7 mm.

C. Median leaves tending to rhomboid (or if ovate, the plants pilose with long, coarse hairs), averaging 40–60 mm. long, the internodes which they subtend commonly 40–130 mm., averaging 70–90 mm...............45. **S. ovalifolia**

CC. Median leaves tending to ovate, prevailingly 30–50 mm. long, the internodes which they subtend commonly 30–50 mm., averaging 40–50 mm. long; plants of Alabama, Georgia, and Florida.......................46. **S. altamaha**

BB. Galea and tube of the corolla 18–35 mm. over all, averaging 21–25 mm. (28–31 mm. in *S. pseudoserrata* and *montana*), the lower pair of stamens attached 7–16 mm. above the base, averaging 8.5–15 mm.

C. Lower surfaces of the leaves hirtellous along the veins with curled, more or less appressed hairs, for the rest nearly glabrous.

D. Galea and tube of corolla 20–22 mm. long, the lower stamens attached 7–10 mm. above the base.

E. Median leaves 20–30 mm. broad, on petioles 5–10 mm. long; plants confined largely to northern central Alabama....39. **S. alabamensis**

EE. Median leaves 25–65 mm. broad, on petioles 15–25 mm. long; plants of the southern Appalachian Mountains, ranging as far as De Kalb County, Alabama.............. ....38. **S. punctata**

DD. Galea and tube of corolla 23–32 mm. long.

E. Stems glabrous in the lower parts, thinly puberulent with curled subappressed hairs in the upper parts, the calyces similarly clothed, sometimes with short stalked glands in addition; lower stamens seated 9–11 mm. above the base of the tube; plants ranging from South Carolina northward........................42. **S. serrata**

EE. Stems pubescent throughout, usually with spreading or somewhat retrorse capitate glands in the lower parts, with curled hairs in the upper, the capitate glands present or absent above.

F. Median leaves oval or ovate, mostly obtuse, on petioles 15–30 mm. long; upper parts of stem eglandular as far as known; plants of adjacent Georgia and South Carolina
40. **S. Mellichampii**

FF. Median leaves tending to be rhomboid-ovate and commonly cuneate at the base, on petioles 5–15 mm. long; stems glandular in the upper parts; plants of the border of eastern Tennessee, western North Carolina and adjacent Georgia
41. **S. pseudoserrata**

CC. Lower surfaces of the leaves evenly pubescent with short curled or spreading hairs.

D. Largest leaves situated near the base of the plant, progressively diminished upward, the median 8–24 mm. wide, averaging about 16 mm.; plants of Florida 47. **S. arenicola**

DD. Largest leaves median, these rarely less than 30 mm. wide, averaging 35–50 mm.

E. Corolla tube exannulate, the galea and tube 26–35 mm. long, the lower stamens attached 11–16 mm. above the base; plants of northwestern Georgia and adjacent Tennessee....................................43. **S. montana**

EE. Corolla tube clearly annulate, the galea and tube 18–25 mm. long, the lower stamens attached 7–11 mm. above the base.

F. Leaf blades and stems pubescent with curled eglandular hairs, these sometimes present at the very base of the stem or on the calyces; plants found west of the Appalachian Mountains.....................37. **S. incana**

FF. Leaf blades and stems pilose-glandular; plants known only from Macon, Georgia.......................................44. **S. Ocmulgee**

37. **S. incana** Spreng., Mant. Fl. Hal. 44, 1807, based probably upon a specimen sent by Muhlenberg.

S. pubescens Muhl., Trans. Am. Phil. Soc. 3: 173, 1793, nomen nudum.

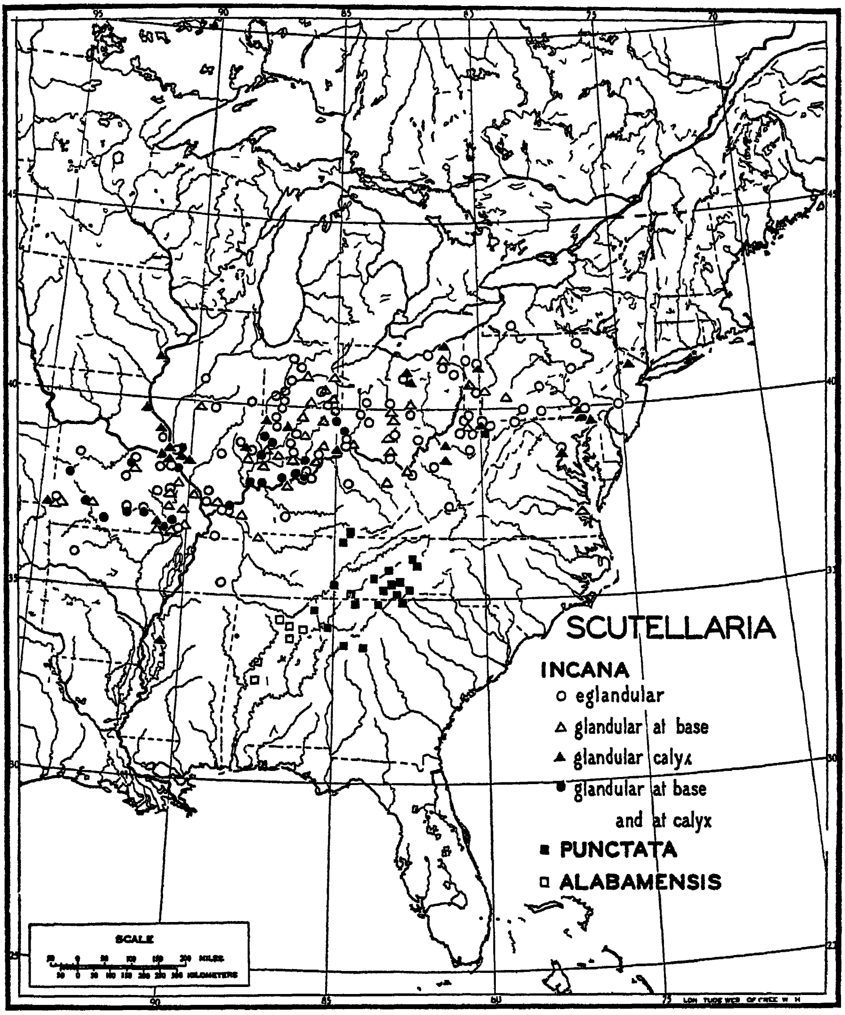
S. canescens Nutt., Gen. Pl. 2: 38, 1818, based upon a collection made by Nuttall near Portsmouth, Ohio; authentic specimens preserved in the Brit. Mus. Nat. Hist. and at the Acad. Sci. Phila. under the name "*S. incana* Muhlenb."

S. serrata Spreng., Syst. Veg. 2: 703, 1825 (not Andrews, 1797; based apparently on *S. pubescens* Muhlenb.; I have no record of a type in the Sprengel herbarium).

S. ?villosa Ell., Bot. S.C. & Ga. 2: 90, 1824 based upon specimens observed or collected in Georgia between Ocmulgee and Flint rivers along road leading from Fort Hawkins to Indian agency.

A perennial herb as much as 120 cm. tall, glabrous in the lowermost internodes or with a pubescence of downwardly curled hairs, less often with spreading capitate glands, evenly pubescent in the upper parts with upwardly curled hairs and apparently always eglandular; lower median leaves commonly cordate or ovate, gradually diminished upwards, 65–120 mm. long, averaging about 85 mm., 30–70 mm. broad, averaging about 50 mm., borne on petioles averaging about 20 mm., their margins crenate-serrate, the upper surfaces glabrate, commonly sprinkled with appressed hairs, the lower *evenly pubescent with short hairs which tend to spread;* flowers in a showy subcormybose panicle, subtended by entire bracts about equal to the calyces; flowering calyces *appressed-hirtellous*, canescent, sometimes with spreading capitate glands as well, the lower lip 3–3.5 mm. long, 6–7 mm. long at maturity, the squama then about 6 mm. tall; galea and tube 18–25 mm. long, averaging 20.5 mm., the lower stamens seated 7–11 mm. above the base of the tube, averaging 8.5 mm.; nutlets dark brown, coarsely verrucose, appearing almost tessellated above, more imbricated toward the base.

As pointed out by Leonard this species is relatively stable. Apart from the shape of the leaves, which may be cordate or rounded at the base, its chief source of variation appears to be in the presence or absence of stalked glands. Some forms are characterized by stalked glands at the base of the stem, some by stalked glands in the inflorescence—particularly on the calyces—and some by both. No geographical correlations are certain. However, a form that has been abundantly collected in Missouri occurs throughout most of the range of the species. It is characterized by a smaller habit, but particularly by the smaller, ovate leaves which are rounded and narrowed at the base, and average 6–7 cm. long and 2.5–3.5 cm. wide. The plants themselves are commonly 40–50 cm. tall. They are almost always glandular at the base and commonly glandular in the inflorescence. They can be collected with the typical form. This "Missouri" form may comprise plants late to develop. Except for sporadic appearance in eastern Pennsylvania, Maryland, and Virginia the species is restricted to the Ohio River Valley, west of the Appalachians and in Missouri. Apparently, no forms are contiguous with *S. punctata.*



Map 18. Distribution of *S. incana, punctata,* and *alabamensis.*

Distribution (see maps 18, 20).—Following is the distribution of the eglandular or nearly eglandular form (of these some may have been glandular at the base, which was not preserved):

DISTRICT OF COLUMBIA. *Steele* 76. ILLINOIS. Champaign, Effingham, Jackson: *Gleason* 2617; Macon, Marion, Massac, Peoria, Richland, Union. INDIANA. Braun: *Friesner* 9757; Cass, Clark, Clay, Fulton: *Deam* 39223; Hendricks, Henry, Jackson: *Deam* 17432; Jefferson, Marshall, Monroe, Montgomery, Owen, Tippecanoe, Wayne, Wells, White: *Deam* 39338. KENTUCKY. Calloway, Fayette, Fulton, Jefferson, Nelson, Warren. MARYLAND.

Allegany, Garret. MISSOURI. Butler, Carter, Dent, Franklin, Greene, Iron, Jasper, Jefferson, Lincoln, Osage, Pettis, Phelps, Shannon: *Bush* 761, 6113; St. Louis, Texas. NEW YORK. Cattaraugus. OHIO. Champaign, Columbiana, Cuyahoga, Delaware, Greene, Hamilton, Hocking, Meigs, Montgomery, Portage, Richland, Ross, Scioto. PENNSYLVANIA. Allegheny, Bedford, Bradford, Franklin, Greene, Huntingdon, Lancaster, Mercer, Montour, Philadelphia. WEST VIRGINIA. Doddridge, Harrison, Kanawha, Mercer, Monongalia, Preston, Upshur, Wayne, Wetzel. WISCONSIN. Lake Pepin.

Following is the distribution of the form that is glandular both on the calyces and at the base. (The abundance of specimens from Indiana and Missouri is partly explained by abundant local collections, nevertheless occasional specimens should have been found in the upper Ohio Valley and eastward, if this form grew there.):

ILLINOIS. Pope: *Herod.* INDIANA. Clark, Crawford, Fayette, Floyd, Greene, Harrison, Knox, Posey, Sullivan, Vanderburg, Washington. IOWA. Louisa: *Pammel* 1692. KANSAS. Cherokee: *Hitchcock* 797. MISSOURI. Carter: *Palmer* 6194; Douglas, Greene, Howell: *Steyermark* 14482; Jefferson: *Steyermark* 1281; Maries: *Steyermark* 15308; Ripley, Shannon: *Bush* 8765; St. Clair: *Bush* 12809; St. Louis, Texas: *Steyermark* 14529; Webster. OHIO. Butler: Oxford. TENNESSEE. Chester: Henderson.

Following is the distribution of the form with glandular calyces; usually the base of the plant was not collected and may have been glandular:

DISTRICT OF COLUMBIA. ILLINOIS. Jasper. INDIANA. Ohio, Vigo. IOWA. Louisa. KANSAS. Cherokee. MISSOURI. Lincoln, Pike, Ralls, Shannon, St. Louis. NEW JERSEY. Sussex. OHIO. Lake, Richland. PENNSYLVANIA. Lancaster, Mercer. WEST VIRGINIA. Calhoun, Monongalia, Wirt.

Following is the distribution of the form which is glandular at the base but eglandular above:

ILLINOIS. Johnson: *Benke* 4775; Menard, Richland: *Palmer* 15657; St. Clair: *Eggert* in 1896. INDIANA. Blackford: *Deam* 44, 1375; Brown: *Friesner* 7588; Daviess, Decatur, Delaware, Dubois, Franklin, Fulton, Grant, Greene: *Deam* 26140; Hamilton: *Friesner* 6050; Huntington, Jackson, Jay, Jennings, Knox, Lawrence, Madison, Marion: *Friesner* 5964, 8852; Martin, Monroe, Montgomery, Morgan, Orange, Parke, Perry, Pike, Randolph, Ripley, Rush, Scott, Spencer, Vigo, Warren, Warrick, Wells. KENTUCKY. Crittenden, Lyon: *Eggleston* 4808; Nelson, Rowan: *Svenson* 4423. MARYLAND. Harford. MISSOURI. Bollinger, Butler, Franklin, Greene, Iron, Jasper: *Palmer* 6272; Oregon, Perry, Phelps, Reynolds: *Eggert* in 1896; Ripley, Shannon, St. Francois, St. Louis: *Eggert* in 1875 and 1892; Wayne: *Eggert* in 1893. OHIO. Franklin, Hamilton: *Lloyd* 417, 2162; Licking, Pickaway, Portage, Richland, Rose: *Demaree* 11492; Scioto: *Demaree* 10776. PENNSYLVANIA. Allegheny, Beaver, Lancaster, Westmoreland, York. TENNESSEE. Robertson. VIRGINIA. York. WEST VIRGINIA. Wetzel.

I believe that these categories, based upon glandular characteristics, indicate fairly well defined tendencies. The ample material collected in Indiana by Deam is suggestive. Of 65 collections made throughout this state, 36 are glandular at the base only, and mostly eglandular above, 11 are glandular at the base and on the calyx as well, and 16 are eglandular. As a rule these forms do not occur together.

38. **S. punctata** Leon., Contrib. U. S. Natl. Herb. 22: 743, 1927.

S. canescens var. *punctata* Chapman, Fl. South. U. S. 323, 1860, based upon specimens collected by Chapman in Florida and presumably near Rome, Georgia; authentic material in U. S. Nat. Herb.; the Florida plants cited by him represent what is here described as *S. Altamaha* subsp. *australis.*

S. incana var. *punctata* Mohr, Bull. Torr. Bot. Club 24:26, 1897.

A perennial herb as tall as 120 cm., glabrous in the lower parts, rarely with a few spreading glandular hairs, appressed-hirtellous above with upwardly curled hairs, apparently always eglandular; lower median leaves usually *narrowly ovate,* less often cordate, gradually diminished upwards, 50–120 mm. long, averaging about 85 mm., *25–65 mm. broad, averaging about 40 mm.,* borne on petioles averaging about 20 mm. long, their margins crenate-serrate, the upper surfaces glabrate, commonly sprinkled with appressed hairs, the lower *glabrous* and *strongly punctate-glandular except on the veins, which are appressed-hirtellous;* flowers in a showy, subcorymbose panicle, subtended by entire bracts about equal to the calyces; flowering calyces *appressed*-hirtellous, canescent, rarely with capitate glands as well, the lower lip 3–3.5 mm. long, 6–7 mm. long at maturity, the squama then about 6 mm. tall; galea and tube 19–22 mm. long, averaging 20.5 mm., the lower stamens seated 7–10 mm. above the base of the tube, averaging 8.5 mm.; nutlets dark brown, coarsely and closely verrucose, appearing almost tessellated above, more imbricated toward the base.

S. punctata is a species of the Appalachian Mountains and, as pointed out by Leonard, is distinct in its range from *S. incana,* which it closely resembles in vegetative and reproductive habit. Only in West Virginia are intermediates to be found, and only here are the two species contiguous. Owing to this fact, and also to the constantly narrower, glabrous leaf, it seems preferable, as suggested by Leonard, to consider this a species. However, the variation of which he speaks is presumably due to inclusion by him of forms referred elsewhere in this paper—notably the Alabama plants. A more conventional view might be to consider *S. punctata* and *S. alabamensis* as "varieties" of *S. incana.* I have observed stalked glands on only four collections: in Bladen and Haywood counties, North Carolina, in Cocke County, Tennessee, and in McCreary County, Kentucky. A plant collected at Balsam, North Carolina, together with typical plants, has much the same habit and pubescence as *S. Mellichampii.*

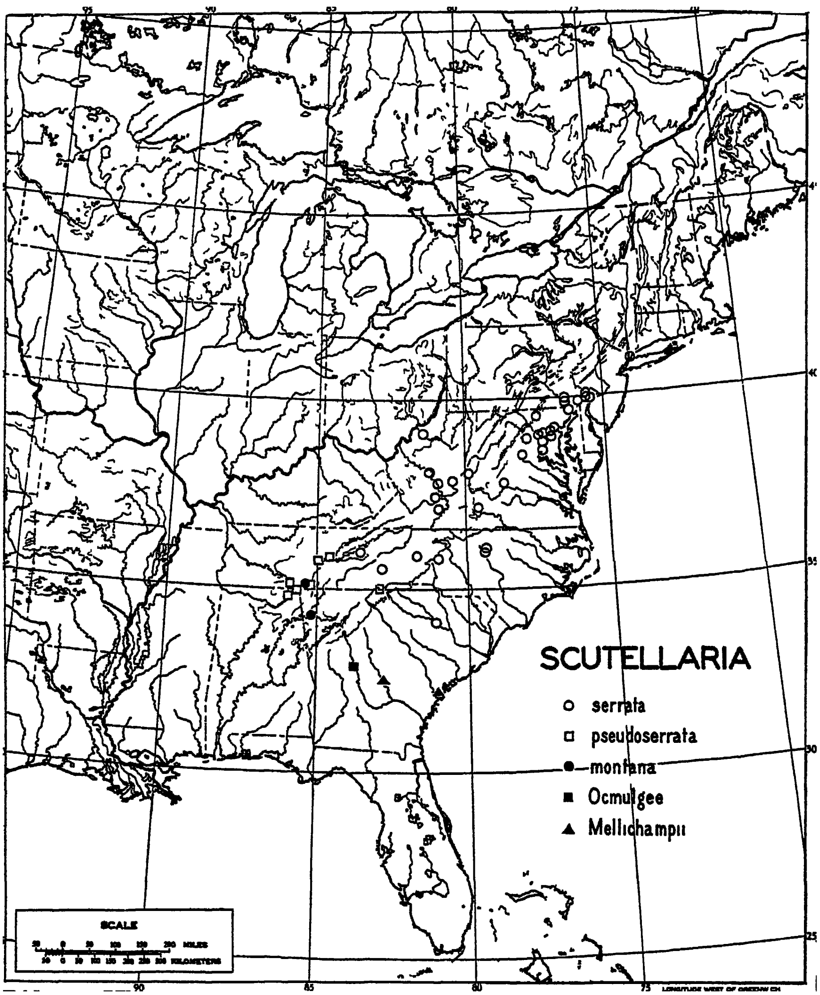
Distribution (see maps 18, 20).—ALABAMA. DeKalb: Little River, Mentone. GEORGIA. Chatham, Fannin, Floyd, Fulton, Gwinnett: *Small* in 1893; Rabun. KENTUCKY. McCreary: south of Pine Knot *Wherry and Pennell* 13901. NORTH CAROLINA. Bladen: *Heller* 14043; Haywood: *Oosting* 34681; *Standley* 5618; Pickens: Table Rock State Park; Swain: *Beardslee and Kofoid* in 1891; Transylvania: *House* 4387; *Biltmore Herb.* 3449. TENNESSEE. Anderson: Clinton; Blount: Cades Cove; Cocke: between Paint Rock and Del Rio *Kearney* 872; Cosby, Haywood: Chestnut branch of Caldwell Creek; Morgan: Rugby *Svenson* 4053; Polk: Hiwassee Valley *Ruth* 522, 539, 3352. WEST VIRGINIA. Calhoun: Pink, Hur; Wirt: Elizabeth.

39. **S. alabamensis** Alexander, *in* Small, Man. Fl. SE. U. S. 1151, 1933; type collected by Eggert at Attalla, Alabama (N. Y. Bot. Gard.).

A perennial herb 30–60 cm. tall; stems glandular at the base with spreading or retrorse capitate glands, pubescent in the upper parts with rather coarse upwardly curled hairs, not glandular so far as known; median leaves prevailingly *oval or oblong, not greatly diminished upward,* 35–60 mm. long, averaging about 50 mm., *20–30 mm. broad, averaging about 25 mm.,* borne on petioles usually 5–10 mm. long, their margins crenate-serrate, both surfaces glabrous except for sessile glands and a few appressed hairs along the veins beneath; flowers subtended by entire bracts about equal to the calyces, disposed in close racemes 5–8 cm. long, usually with a pair of short auxiliary branches at the base; flowering calyces *bristly with spreading capitate glands* and some upwardly curled hairs, the lower lip 3 mm. long, not seen at maturity; galea and tube 20–22 mm. long, the lower stamens seated 9–10 mm. above the base of the tube; nutlets unknown.

This species, together with its allies, seems to be of hybrid origin, and somewhat suggests a depauperate *S. punctata,* which in turn resembles one of the species with elongate internodes, such as *S. ovalifolia. S. Mellichampii* seems of similar origin. *S. Altamaha* is similar in habit but can be distinguished by the smaller flowers. Specimens from Blount and Cullman counties, Alabama, are referred to *S. alabamensis;* however, as no flowers are preserved, they may be *S. Altamaha.*

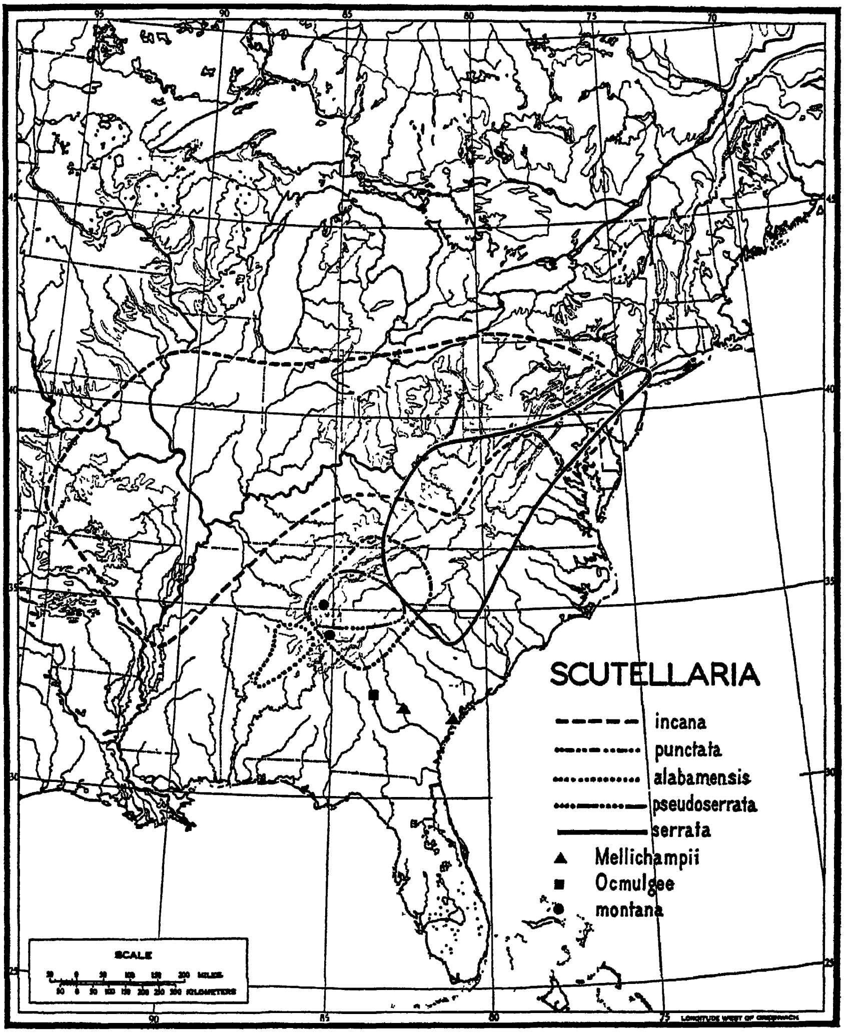
Distribution (see maps 18, 20).—ALABAMA. Blount: Mulberry River *Mohr* in 1883; Cullman: no locality *Mohr* in 1895; Etowah: north of Littleton *Eggert* in 1898; Attalla *Eggert* in 1897; Gadsden *Vasey* in 1877; Hale: Greensboro *Watson* in 1857; St. Clair: hills north of Springville *Eggert* in 1898; Tuscaloosa: Tuscaloosa *Vasey* in 1878.



Map 19. Distribution of *S. serrata, pseudoserrata, montana, Ocmulgee,* and *Mellichampii.*

40. **S. Mellichampii** Small, Man. Fl. SE. U. S. 1022, 1903; type collected by Mellichamp near Bluffton, South Carolina (N. Y. Bot. Gard.).

A perennial herb 30–60 cm. tall; stems glandular at the base with spreading or retrorse capitate glands, pubescent in the upper parts with upwardly curled hairs, not glandular so far as known; median leaves prevailingly *ovate,* rounded or rounded-truncate at the base with convex crenate margins and obtuse tip, not greatly diminished upward, 70–95 mm. long, averaging about 75 mm., *35–55 mm. broad, averaging about 45 mm.,* borne on petioles 15–30 mm. long, both surfaces nearly glabrous, the upper with a few appressed hairs, the lower with a few appressed hairs on the veins; flowers subtended by entire bracts about equal to the calyces, disposed usually in a close panicle 5–15 cm. long, the lateral branches 2–3 cm. long; flowering calyces eglandular with longish but upwardly curled hairs, the lower lip 3 mm. long, not seen at maturity; galea and tube 23–29 mm. long, the lower stamens seated 11–13 mm. above the base of the tube; nutlets unknown.



Map 20. Limits of certain species of the section *Annulatae* (abstracted from maps 18, 19).

S. Mellichampii is thus similar in many respects to *S. alabamensis,* differing especially in the larger, more oval leaves. It also seems of hybrid origin. It occurs with *S. Altamaha,* and may be distinguished from that species by the larger flowers and leaves.

Distribution (see maps 19, 20).—The species is known to occur at only two places: GEORGIA. Laurens: Oconee River banks below Dublin *Harper* 1368 (*S. Altamaha* also occurs here); "Sunbury" *LeConte*. SOUTH CAROLINA. Beaufort: Bluffton *Mellichamp* 14, 286.

41. **S. pseudoserrata** sp. nov.; type (collector unknown) from near Stevenson, Alabama (U.S. Natl. Herb.).

Herba perennis altitudine 20–60 cm. caulibus ad basim pilis extensis vel retrorsis capitato-glandulosis conspersis superne pilis crispis *et capitatis* sat dense pubescentibus; foliorum mediorum laminis variis saepius ovatis in basi acuminatis in apice saepius acutis longitudine 55–75 mm. latitudine 25–45 mm., pagina superiore sparse appresso-hirsuta, inferiore solum ad venas appresso-hirtella, petiolis 5–15 mm. longis elatis; floribus superioribus bracteis integris calyces subaequantibus subtentis inferioribus in foliorum axillis dispositis, in racemis 5–15 cm. longis dispositis; calycibus florentibus *pilis capitatis glandulosis ornatis*, labia inferiore 3–3.5 mm. longa; galea et tubo 24–32 mm. longo, staminibus inferioribus supra tubi basim 10–15 mm. positis; nuculis non visis.

This supposed species is almost certainly of hybrid origin, and may consist only of hybrids of various nature. It varies considerably, suggesting either *S. serrata,* from which it is distinguished by the glandular indumentum of the stem, or *S. montana,* from which it may be distinguished by the presence of the annulus and the glabrate foliage. One form collected on Lookout Mountain suggests, in its elongate internodes, the habit of *S. ovalifolia.* The flower size is unusually variable for this section. Hybrids of these species, once formed, might persist locally owing to underground reproduction.

Distribution (see maps 19, 20).—ALABAMA. Jackson: Stevenson *Mohr* in 1899. NORTH CAROLINA. Macon: Highlands *Harbison* in 1904. TENNESSEE. Franklin: Sewanee *Sheldon* 271; Hamilton: Lookout Mountain *Churchill* in 1911; *Canby* in 1869 (*S. montana, S. ovalifolia* subsp. *hirsuta* and *S. integrifolia* also occur here); Marion: Sand Mountain, Dodds *Graves* 1049; Rhea: Rockwood *Anderson and Jennison* 1269.

42. **S. serrata** Andr., Bot. Rept. t. 494, 1797, based upon a garden specimen; the type is unknown to me.

A slender perennial 25–60 cm. tall with one or two erect stems arising from a short rhizome, glabrous except in the inflorescence; lowermost leaf blades ovate, 2–3 cm. long on subequal petioles, soon deciduous, glabrous or with a few coarse, spreading hairs, the median prevailingly ovate or oval, seldom elliptical, *40–120 mm. long, averaging about 8 cm., 25–60 mm. broad, averaging about 40 mm.*, shortly acuminate at the tip, rounded at the base and abruptly acuminate, borne on petioles 5–25 mm. long, their margins regularly serrate, both surfaces glabrous or hirtellous along the veins; flowers in racemes commonly 8–10 cm. long, hirtellous with ascendent curved hairs, particularly on the angles, infrequently sprinkled also with small capitate glands, the bracts entire, somewhat exceeding the calyces, hirtellous; calyces usually red-margined, clothed like the stems, sometimes glandular, the lower lip 3 mm. long at anthesis, 6 mm. long at maturity, the squama then about 5 mm. tall; corolla deep violet, the galea and tube 23–26 mm. long, the lower lip glabrous; lower stamens seated 9–11 mm. above the base of the tube; nutlets brown, covered with laminate processes.

This species, although difficult to distinguish from its allies in words, is nevertheless one of the most readily recognizable and most constant in the section. It varies chiefly in the presence or absence of stalked glands on the calyx. When present, they occur throughout the range, except in the periphery, namely in West Virginia and South Carolina.

Distribution (see maps 19, 20).—DISTRICT OF COLUMBIA. *Steele* 77; *Pollard* 277. MARYLAND. Baltimore: Baltimore, Frederick, Orange Grove; Cecil: Conowingo; Howard:

Patapso Valley; Montgomery: Cabin John *Killip* 12459; Chevy Chase Lake *Standley* 5975; Forest Glen *Standley* 8863; Glen Echo, Great Falls, Rock Creek *Maxon and Standley* 138; Woodside. NORTH CAROLINA. Avery: Cranberry Fork; Buncombe: Biltmore *Biltmore Herb.* 1250; Caldwell: Lenoir; Iredell: Statesville; Orange: Chapel Hill *Ashe* 6445; Hillsboro. PENNSYLVANIA. Delaware: Castle Rock, Sycamore Mills, Darby, Edgemont, Swarthmore, Wawa; Lancaster: Chester, Rawlinsville; York: Ferry, York Furnace, McCall. SOUTH CAROLINA. Richland: Columbia. TENNESSEE. Jefferson: Dandridge. VIRGINIA. Albermarle: Millers School; Bath: Nimrod Hall; Bedford: *Curtiss* 6620; Peaks of Otter; Culpeper: Culpeper *Allard* 1469; Fairfax: Dead Run *Leonard and Killip* 646; Mount Vernon *House* 858; Middleburg; Giles: Pearisburg *Fogg* 15093; Beanfield Mountain *Fogg* 13095; Goodwins Ferry *Fogg* 14959; Montgomery: Blacksburg; Prince William: Occoquam. Roanoke: Salem *Wood* 836. WEST VIRGINIA. Cabell: Gayan Creek *Gilbert* 320; Fayette: Nuttallburg; Greenbrier: White Sulphur Springs; Mercer: Athens; Summers: Hinton; Wirt: Owensport.

(Specimens collected in McLeans Woods, The Bronx, New York City, are doubtless introduced.)

43. **S. montana** Chapman, Bot. Gaz. 3: 11, 1878, based upon specimens collected near Rome, Georgia, by Chapman; authentic material in U. S. Natl. Herb.

A perennial herb 20–60 cm. tall; stems *clothed throughout with somewhat retrorse capitate-glandular hairs;* median leaves prevailingly ovate, 50–80 mm. long, 30–40 mm. broad, crenate-serrate, *softly hirsute on both surfaces with straight hairs,* borne on petioles 10–15 mm. long; flowers disposed in racemes 10–15 cm. long, the upper in the axils of bracts about equal to the calyces, the lower in the axils of the uppermost leaves; flowering calyces *glandular* with spreading straight hairs, the lower lip 3.5–4 mm. long, not seen at maturity; galea and tube 26–35 mm. long, *exannulate,* the lower stamens seated 11–16 mm. above the base of the tube; nutlets unknown.

This species is unique in the section by reason of the exannulate corolla. It may form part of a hybrid series together with *S. pseudoserrata,* with which it occurs on Lookout Mountain.

So far as the present evidence indicates, *S. montana* is separable from most of its allies by the pubescence of the lower leaf surface and glandular stems, as well as the large exannulate corolla. The pubescence suggests that of *S. ovata;* indeed, the plant might readily be interpreted as coming from that species and *S. serrata.*

Distribution (see maps 19, 20).—GEORGIA. Catoosa: Chickamauga Park *Tidestrom* in 1898; Floyd: Rome *Chapman.* TENNESSEE. Hamilton: Lookout Mountain, near Chattanooga *Churchill* in 1911 (*S. pseudoserrata, S. integrifolia* and *S. ovalifolia* subsp. *hirsuta* also occur here); Signal Mountain, Chattanooga *Sowden* in 1923.

44. **S. Ocmulgee** Small, Bull. Torr. Bot. Club 25: 142, 1898; type collected by Small in the Ocmulgee River swamp near Macon, Georgia (N. Y. Bot. Gard.).

A perennial herb about 60 cm. tall, its stems *clothed throughout with spreading capitate glands* and curled hairs in the upper parts, apparently viscid; lower leaves subrotund, the median 50–65 mm. in diameter, broadly ovate or subrotund, subcordate at the base, crenate, borne on petioles 20–25 mm. long, both surfaces softly pilose, clothed like the stems; flowers in close panicles 15–20 cm. long, disposed chiefly in the axils of entire bracts about equal to the calyces; flowering calyces *hirtellous with upwardly curled hairs, apparently not glandular,* the lower lip 3.5 mm. long, not seen at maturity; galea and tube 23 mm. long, the lower stamens seated 9 mm. above the base of the tube; nutlets unknown. This species suggests *S. Mellichampii* with the pubescence of *S. ovata.*

Distribution (see maps 19, 20).—Known only from the collection cited.

45. **S. ovalifolia** Pers., Syn. Pl. 2: 136, 1807, based apparently upon Plukenet's figure in Alm. 338, t. 313, f. 4, 1696; Plukenet's specimen is preserved in the British Museum and may be taken as the type.

45*a*. Subsp. **mollis** nom. nov., based upon Plukenet's specimen.

S. elliptica Muhl., Trans. Amer. Phil. Soc. 3: 173, 1793, nomen nudum.

S. elliptica Spreng., Mant. Fl. Hal., 44, 1807, probably based upon a specimen sent by Muhlenberg.

S. pilosa Michx., Fl. Bor. Am. 2: 11, 1803, in part; (not of Hill, 1768) based upon Michaux's collections now in the Natural History Museum at Paris.

S. nemorosa Raf., Am. Monthly Mag. 2 (2): 120, 1817, based upon a collection made by Rafinesque near Flatbush, Long Island, New York; authentic material in Delessert Herb. and in Mus. Hist. Nat., Paris.

S. pilosa var. *ovalifolia* Benth., DC. Prodr. 12: 423, 1848; type collected in New Jersey near Princeton (N. Y. Bot. Gard.).

S. polymorpha var. *ovalifolia* A. Hamilt., Ann. Soc. Linn. Lyon 1: 39, 1832.

A perennial herb commonly 25–40 cm. tall, its stems pilose in the lower parts with *fine* spreading or somewhat retrorse hairs, more or less capitate-glandular, these passing above into *upwardly curled hairs* which usually occur equally on all faces of the stem, some capitate glands usually present in the inflorescence; basal leaves *deltoid*, commonly 1.5–3 cm. long on subequal petioles, these passing rather abruptly into the rhomboid-oval median leaves 35–60 mm. long, averaging about 50 mm., 20–40 mm. broad, averaging about 25–30 mm., borne on petioles mostly 5–15 mm. long, their margins rather shallowly crenate, both surfaces *thinly hirsute with straight hairs*, confined on the lower surface chiefly to the veins, the internodes which they subtend *40–130 mm., averaging about 70–90 mm.;* flowers disposed in racemes commonly 3–8 cm. long, frequently paniculate, subtended by entire bracts subequal to the calyces; flowering calyces bristling with glandular spreading hairs, usually with some upwardly curled hairs as well, the lower lip barely 3 mm. long, 4–5 mm. at maturity, the squama then about 5 mm. tall; galea and tube 14–21 mm. long, averaging 17 mm.; the lower stamens seated 6–8 mm. above the base of the tube; nutlets dark brown, coarsely covered with thickish subimbricated squamellae.

Distribution (see maps 21, 22).—ARKANSAS. Fulton, Hot Spring, Logan. DELAWARE. New Castle. DISTRICT OF COLUMBIA. *House* 1031. GEORGIA. Cobb. KENTUCKY. Bell, Warren. LOUISIANA. Natchitoches: *Palmer* 7964; Rapides: *Ball* 656. MARYLAND. Caroline, Charles, Harford, Prince Georges: *Blake* 9511; Montgomery. MISSISSIPPI. Jackson. MISSOURI. Laclede: *Steyermark* 13883; Ozark: *Palmer* 32885, 34777; Reynolds, Ripley, Stone: *Palmer* 5802; Taney. NEW JERSEY. Burlington, Camden, Cape May, Gloucester, Hunterdon: *Mackenzie* 7060; Middlesex, Monmouth, Morris, Salem, Somerset, Sussex: *Mackenzie* 4936; Warren: *Mackenzie* 4697. NEW YORK. Bronx, Nassau, Queens, Richmond, Ulster. NORTH CAROLINA. Buncombe: *Biltmore Herb.* 956; Catawba: *Heller* 1017; Guilford: *Wiegand and Manning* 2791; Halifax, Henderson, Iredell, Lincoln, Pasquotank: *Wiegand and Manning* 2790; Polk, Rockingham, Surry, Swain. PENNSYLVANIA. Allegheny, Berks, Bucks, Chester, Cumberland, Dauphin, Delaware, Fayette, Franklin, Lancaster, Lebanon, Lehigh, Monroe, Montgomery, Northampton, Philadelphia, Perry, Pike, Snyder, Schuylkill, York. SOUTH CAROLINA. Anderson, Cherokee: *House* 2527; Clarendon, Lexington, Oconee. TENNESSEE. Cocke: *Kearney* 871; Knox. VIRGINIA. Arlington: *House* 1046; Bedford: *Curtiss* 6929; Buckingham, Fauquier: *Allard* 205, 678; Fluvanna, Giles, Halifax, Henrico, Montgomery, Page: *Camp* 1385; Norfolk, Northampton, Prince George, Prince William, Princess Anne, Shenandoah, Warren, York. WEST VIRGINIA (most of the specimens from here are intermediates): Cabell, Calhoun, Fayette, Hampshire, Harrison, Marion, Monongalia, Roane, Summers, Upshur, Wetzel, Wirt.

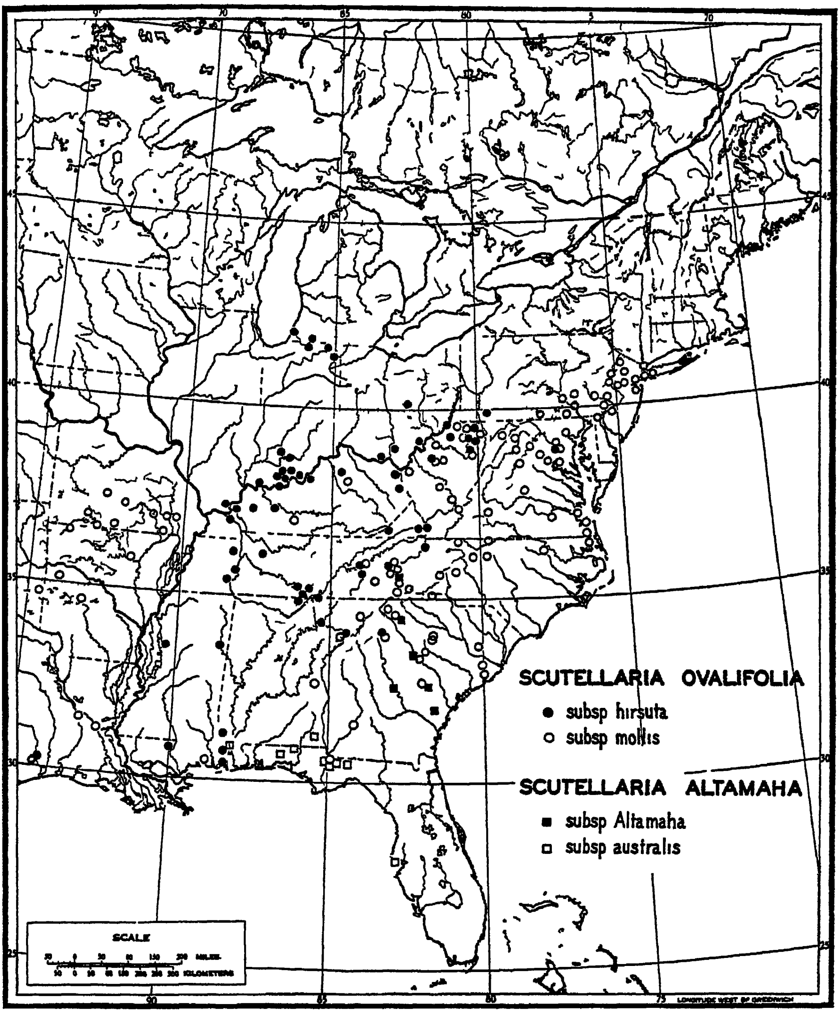
An intermediate form also appears as follows: OKLAHOMA. LeFlore: near Page *Stevens* 2732. ARKANSAS. Carroll, Garland. MISSOURI. Ozark, Shannon, Taney, Wayne, Wright.

45*b*. Subsp. **hirsuta** comb. nov.

S. hirsuta Short, Transylv. Jour. Med. 8: 582, 1836, which is based upon specimens collected by Griswold near Louisville, Kentucky; probable type in herb. of Acad. Nat. Sci. Phila.

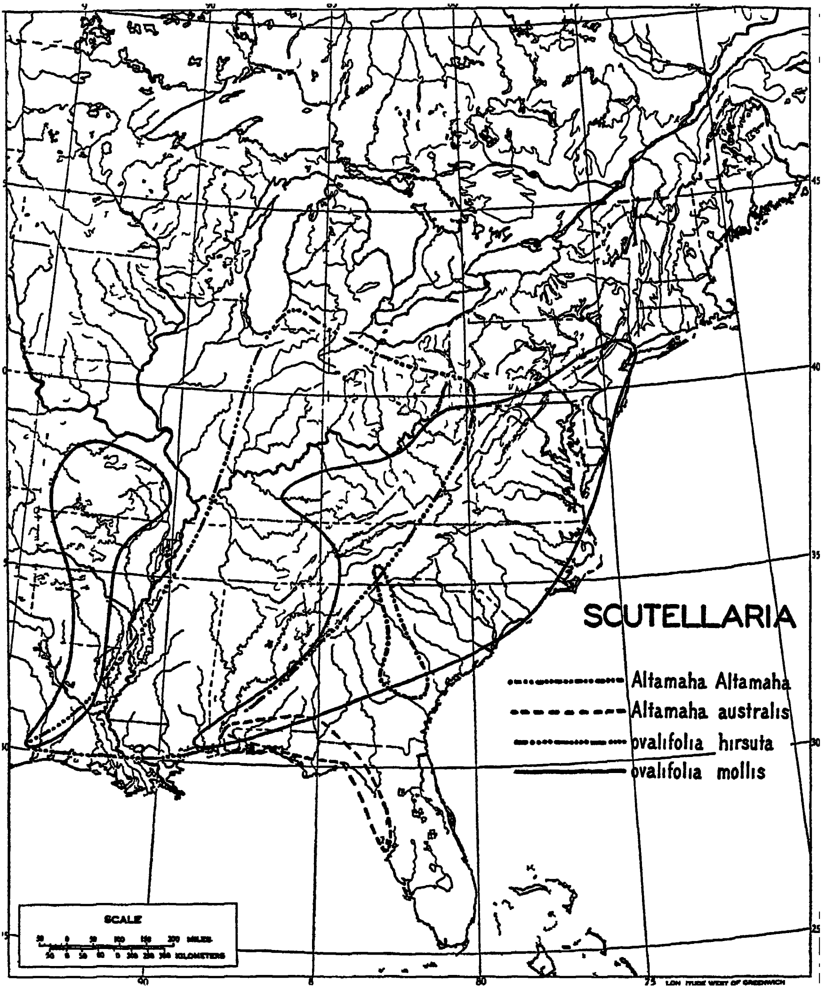
S. pilosa var. *hirsuta* Gray, Syn. Fl. 2: 379, 1878.

Similar in habit to the previous subspecies but *pilose throughout with coarse hairs as much as 2 mm. long,* these more or less glandular at the tip and *mostly straight and spreading* near or in the inflorescence, *any curled hairs usually on alternate faces of the stem;* median leaves tending ot deltoid rather than rhomboid, coarsely crenate, about 30–60 mm. long, averaging 45 mm., 20–60 mm. broad, averaging about 30 mm., borne *on petioles mostly 10–25 mm. long, the internodes which they subtend 40–130 mm., averaging about 80 mm.*



Map 21. Distribution of *S. ovalifolia* and *Altamaha.*

So far as may be determined from the ample herbarium material available, no intermediates with subsp. *mollis* occur in the *hirsuta* area proper, although some occur towards its periphery (see maps 20, 21). However, plants with coarser hairs which are nevertheless usually curled in the upper parts of the plant, occur throughout most of the range of subsp. *mollis,* and have its habit. The pubescence of subsp. *hirsuta* is less variable and more readily recognized. In its variation *S. ovalifolia* offers a condition parallel to that in the closely related *S. integrifolia* Both are characterized by forms with spreading, rather long hairs. In each the hirsute condition is also associated with broader, more deltoid or rhombic leaves, which are more deeply crenate.



Map 22. Limits of *S. ovalifolia* and *Altamaha* (abstracted from map 20)

Distribution (see maps 21, 22).—ALABAMA. Etowah, Jackson *Graves* 1048; Lee *Earle and Baker,* May 29 and June 5, 1897; Mobile: *Graves* 687. GEORGIA. Clarke, Cobb, Dougherty, Floyd, Lumpkin, Richmond, Walker: *Ruth* 518, 527, 544. ILLINOIS. Pope: *Palmer* 15399. INDIANA. Clark, Crawford: *Deam* 20417, 44596; De Kalb, Dubois, Elkhart, Harrison: *Deam* 20516; Lagrange, Martin, Orange, Perry, Spencer, Warrick. KENTUCKY. Boyd, Breckinridge, Caldwell, Jefferson, Johnson, Lyon, Marshall, Muhlenberg, Nelson, Owen: *Runyon* 1302. MICHIGAN. Berrien, St. Joseph. MISSISSIPPI Holmes, Jackson: *Tracy*

4451; *Skehan* 112, 2622; Noxubee. NORTH CAROLINA. Catawba, Watauga. OHIO. Jackson, Meigs, Scioto: *Demaree* 10742. PENNSYLVANIA. Allegheny, Fayette. TENNESSEE. Benton, Blount, Coffee, Decatur, Dickson, Franklin, Knox, Sevier, Washington. TEXAS. Tarrant: Fort Worth *Ruth* 229. VIRGINIA. Smyth, Wise. WEST VIRGINIA. Barbour, Cabell, Calhoun, Harrison, Roane, Tyler, Upshur.

46. **S. Altamaha** Small, Bull. Torr. Bot. Club 25: 143, 1898; type collected by Small in the Altamaha River Swamp, Liberty County, Georgia (N. Y. Bot. Gard.).

46*a*. Subsp. **Altamaha** nom. nov. based upon Small's specimen.

A perennial herb commonly 40–60 cm. tall, its stems glandular with small spreading or retrorse capitate glands *only in the lowermost parts,* soon passing into rather coarse upwardly curled hairs; basal leaves *ovate* rather than deltoid, passing into the larger median leaves *which tend to be ovate or oblong* rather than deltoid, 30–60 mm. long, 18–34 mm. broad, borne on petioles commonly 5–15 mm. long, their margins tending to be serrate rather than crenate, the upper surfaces glabrate, the lower hirtellous along the veins, the internodes which they subtend *commonly 30–50 mm.* long; flowers disposed in racemes commonly 3–8 cm. long, subtended by entire bracts subequal to the calyces, *commonly paniculate,* the panicles often twice branched, 15–20 cm. long; flowering calyces tending to be canescent with rather coarse, upwardly curled hairs, *eglandular,* the lower lip barely 3 mm. long, about 5 mm. long at maturity, the squama then subequal, galea and tube 14–18 mm. long, the lower stamens seated 5–7 mm. above the base of the tube; mature nutlets unknown.

Distribution (see maps 21, 22).—GEORGIA. Jenkins: thickets near Millen *Curtiss* 6826; Laurens: pine barrens 2 miles west of Dublin *Harper* 1358 (*S. Mellichampii* occurs here); Liberty: Altamaha River Swamp *Small* in 1895; Sandy open oak woods 4 miles southwest of Hinesville *Wiegand and Manning* 2779; Richmond: Augusta *Cuthbert* 273, 276, 558. NORTH CAROLINA. Haywood: Waynesville *Harbison;* Henderson: Chimney Rock to Hendersonville *Small and Huger.* SOUTH CAROLINA. Anderson: Andersonville *Gibbs;* York: Red River *Hale.*

46*b*. Subsp. **australis** subsp. nov.; type collected by Wiegand and Manning (no. 2782) in pine woods near Dothan, Houston County, Alabama (Gray).

Similis caulibus superne et calycibus pilis crispis et capitato-glandulosis conspersis; foliorum laminis longioribus et latioribus saepius oblongis petiolis saepius 10–20 mm. longis elatis, internodiis brevoribus.

This species apparently occurs in two unconnected areas, and in each area exhibits a somewhat different facies, but this observation may be due to insufficient exploration and material. *S. multiglandulosa* has a similar distribution, but the plants of the two areas are not appreciably different. *S. Altamaha* exhibits marked variability, suggesting *S. alabamensis, S. punctata,* or *S. ovalifolia* in habit. A specimen collected by Small at Tallahassee is apparently subsp. *australis* but is eglandular. The type has shorter petioles than are typical of the specimens associated with it.

Distribution (see maps 21, 22).—ALABAMA. Houston: pine woods 10 miles south of Dothan *Wiegand and Manning* 2782; Mobile: Chestings Bluff *Mohr.* FLORIDA. Holmes: Ponce de Leon *Curtiss* 6935; Gadsden: Chattahoochee *Chapman;* Quincy *Chapman;* River Junction *Nash* 2384; Leon: Bellair *Nash* 2555; Tallahassee *Berg;* Liberty: Aspalaga *Chapman;* Rock Bluff *Wiegand and Manning* 2780; Walton: no locality *Curtiss.*

S. ovalifolia subsp. *hirsuta* and *S. integrifolia* subsp. *hispida* occur in the vicinity of Mobile. *S. integrifolia* subsp. *hispida, S. ovalifolia* subsp. *mollis, S. multiglandulosa, S. arenicola,* and *S. floridana* occur generally throughout the area occupied by this species in Florida.

47. **S. arenicola** Small, Bull. Torr. Bot. Club 25: 143, 1898; type collected by Nash (no. 1316) near Eustis, Lake County, Florida (N. Y. Bot. Gard.).

A perennial herb commonly 30–45 cm. tall, as much as 70 cm., rarely as low as 15–20 cm., with one or two stems arising from a short rhizome, usually well branched in the inflorescence, the lowermost internodes sometimes with spreading or retrorse hairs, rarely capitate-glandular, more commonly clothed like the upper, which are rather uniformly villous with somewhat coarse upwardly curled hairs, rarely with spreading capitate glands; basal leaves of well-developed plants deltoid-ovate or even deltoid, on slender petioles subequal to the blade, the basal leaves somewhat larger but narrower in proportion and cuneate at the base, as much as 5 cm. long, *the median progressively smaller and more elliptical* and on shorter petioles but usually cuneate at the base and broadest below the middle, the blades 20–34 cm. long, *8–24 mm.* broad, all irregularly and rather deeply serrate, passing into the rather abruptly diminished entire bracts, the lower leaves clothed about as the stems, the upper sparingly hirtellous with small upwardly curved hairs or all nearly glabrous; flowers in the axils of bracts; flowering calyces hirtellous with small upwardly curled hairs and often with short, spreading capitate glands, especially below, the lower lip 3 mm. long, somewhat longer at maturity, the squama then about 7 mm. in diameter; galea and tube 22–29 mm. long, the lower stamens seated 9–12 mm. above the base of the tube.

Though difficult to segregate from its allies by means of words, *S. arenicola* is nevertheless readily recognized and fairly uniform. Once learned, its rather villous, upwardly curled pubescence is distinctive. This is also true of its habit, in which the basal leaves are largest, the median being gradually diminished, and, like *S. multiglandulosa,* subtending internodes which average about the same as the leaves in length. It is most readily confused with the broad-leaved forms of *S. integrifolia* subsp. *hispida,* from which it can be distinguished by the characters just mentioned.

Distribution (see maps 23, 24).—FLORIDA. Citrus: Homosassa; Duval: Jacksonville (*S. integrifolia hispida* occurs here) *Peters* 39; *Curtiss* 5671; Orange City; Volusia (*S. integrifolia hispida* occurs here), Hernando: Brooksville *Small* et al. 11476, 11478; Highlands: Sebring (*S. integrifolia hispida* occurs near here) *Small* et al. 11488; Hillsborough: Tampa (*S. multiglandulosa* and *S. glabriuscula* occur here) *Curtiss* 2058; Lake: Eustis (with *S. multiglandulosa*) *Nash* 1316, 1375; *Webber* 514; Leesburg; Lee: Fort Myers (these specimens tend toward *S. integrifolia* subsp. *hispida,* which occurs here) *Eaton* 1153, 1410; *Hitchcock* 277; *Standley* 440; Manatee: Marion (with *S. multiglandulosa*), Oneco (*S. glabriuscula* occurs here); Orange: (*S. glabriuscula* occurs here) *Fredholm* 5363; Lake Brantley, Oakland, Orlando *Curtiss* 6669; Pasco: Ehren; Polk: Fort Meade (*S. integrifolia* subsp. *hispida* occurs here), Lakeland *McFarlin* 6062; Seminole: Forest City.

48. **S. integrifolia** L., Sp. Pl. 599, 1753; type collected by Clayton in Virginia (no. 205), formerly in Gronovius herb., now in Brit. Mus. Nat. Hist.

S. polymorpha A. Hamilt., Ann. Soc. Linn. Lyon, 1: 38, 1832, a name given to the Linnaean species.

48*a*. Subsp. **typica** nom. nov., based upon Clayton no. 205.

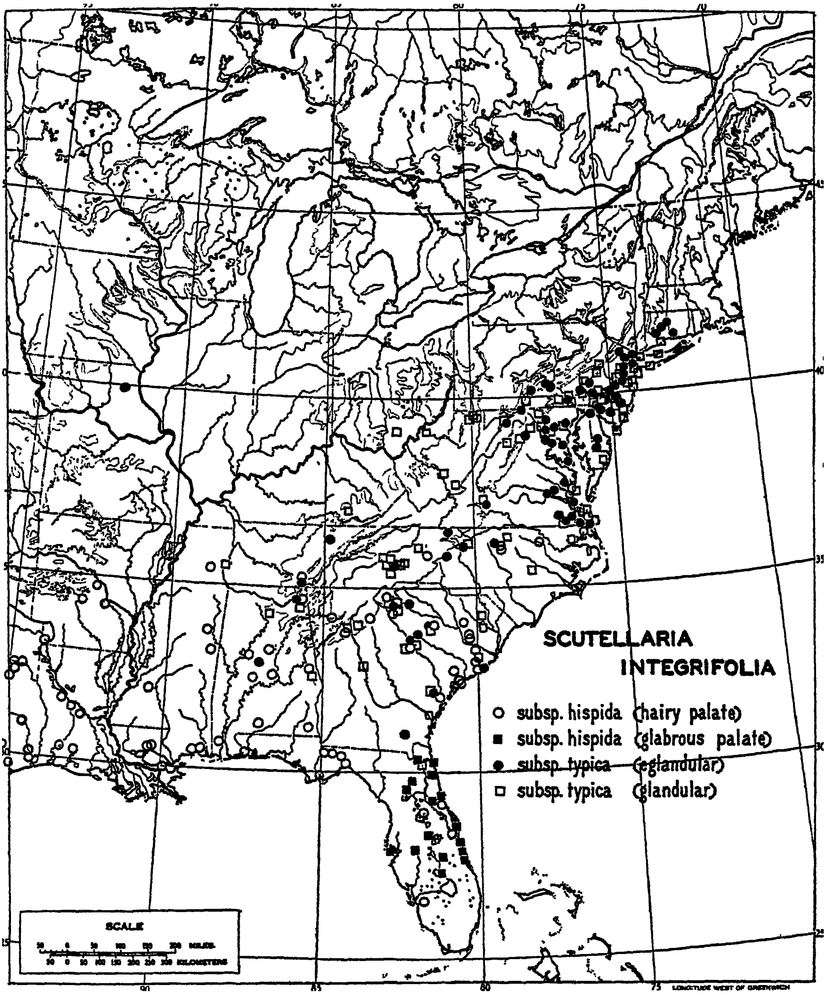
S. hyssopifolia L., Sp. Pl. 599, 1753; type collected by Clayton (no. 261) in Virginia (Brit. Mus.).

S. integrifolia var. *hyssopifolia* Millsp., Fl. W. Va. 427, 1892.

S. ?caroliniana Lam., Encycl. 7: 706, 1806; type collected in Carolina by Fraser (Paris).

S. polymorpha var. *hyssopifolia* A. Hamilt., Ann. Soc. Linn. Lyon 1: 38, 1832.

A perennial herb commonly 30–60 cm. tall, its stems clothed with upwardly curled hairs from the very base, or with short spreading hairs in the lowermost parts, some of these infrequently glandular, eglandular in the inflorescence or sprinkled there with capitate glands; basal leaves ovate or oval rather than deltoid, frequently entire, infrequently longer than 2 cm., on subequal petioles, passing soon into the narrowly elliptical *entire* median leaves 20–60 mm. long, averaging about 35 mm., 5–16 mm. broad, *averaging about 10 mm.*, borne on petioles 2–10 mm. long, both surfaces *hirtellous with curled and subappressed hairs,* the upper often glabrate, the internodes which they subtend 25–85 mm. long, averaging about 50 mm.; flowers disposed in racemes commonly 5–10 cm. long, often with a pair of short auxiliary branches at the base, but scarcely paniculate, subtended by the upper diminished leaves which at the apex of the branch are subequal to the calyces; flowering calyces eglandular with short spreading hairs, or with spreading capitate glands as well, the lower lip 3 mm. long, 5–6 mm. long at maturity, the squama then subequal; galea and tube 18–26 mm. long, averaging 23 mm., the lower stamens seated 7–11 mm. above the base of the tube, averaging 8.5 mm.; nutlets dark brown, coarsely covered with thickish subimbricated squamellae.


SCUTELLARIA
INTEGRIFOLIA
○ subsp. hispida (hairy palate)
■ subsp. hispida (glabrous palate)
~~● subsp. typica (eglandular)~~
□ subsp. typica (glandular)
SCALE
MILES
KILOMETERS
90
85
80
75
45
40
35
30
25
LONGITUDE WEST OF GREENWICH

Map 23. Distribution of *S. integrifolia.*

This subspecies appears to comprise two races; one in which few or no stalked glands are apparent on the calyces and in the inflorescence, and a second in which these are readily seen. The first appears to occupy the Atlantic coastal plain, from Massachusetts to Georgia. The second seems to occur largely west of the Appalachian Mountains, although frequent in Delaware, New Jersey, and eastern Pennsylvania.

Distribution (see maps 24, 25).—*Eglandular Race:* ALABAMA. Bibb, DeKalb, Escambia, Jackson: *Graves* 1046. CONNECTICUT. Hartford, Middlesex, New Haven. DELAWARE. New Castle, Sussex. DISTRICT OF COLUMBIA. *Pollard* 393. GEORGIA. Bulloch: *Harper* 885; Richmond, Ware. MARYLAND. Allegany, Anne Arundel, Baltimore, Cecil, Harford, Montgomery, New Castle, Prince Georges, St. Charles, St. Marys, Sussex, Talbot, Worcester. MISSOURI. Shelby. NEW JERSEY. Atlantic: *Gross* 2060; Bergen, Burlington: *Mackenzie* 6512; Cape May, Camden, Cumberland, Essex: *Mackenzie* 1456; Hudson, Gloucester, Mercer, Middlesex: *Mackenzie* 1475; Morris, Monmouth, Ocean, Passaic, Salem, Somerset, Union. NEW YORK. Richmond. NORTH CAROLINA. Buncombe: *Biltmore* 954; Catawba, Durham, Forsyth, Iredell, Orange: *Oosting* 3398; Surry. PENNSYLVANIA. Berks, Bucks, Chester: *Bartram* 1078; Cumberland, Delaware, Franklin, Lancaster, Lebanon, Monroe, Montgomery, Perry, Philadelphia, Schuylkill, Snyder. SOUTH CAROLINA. Aiken, Anderson, Berkeley, Laurens, Lexington. TENNESSEE. Cumberland, Marion, Morgan. VIRGINIA. Bedford, Fairfax, Fauquier, Gloucester, Halifax, Hanover, Henrico, James City: *Grimes* 3644; Mecklenburg, Middlesex, Nansemond: *Heller* 930; Norfolk, Princess Anne, Sussex: *Wiegand and Manning* 2783; Warwick, York. WEST VIRGINIA. Hampshire.

Glandular race: ALABAMA. Cullman, DeKalb: *Ruth* 514, 523, 540; Lee. CONNECTICUT. New Haven. DELAWARE. New Castle. DISTRICT OF COLUMBIA. *House* 1038. FLORIDA. Duval. GEORGIA. Bibb, Bulloch, DeKalb, Gwinnett, McIntosh, Richmond. KENTUCKY. Laurel. MARYLAND. Baltimore, Frederick, Montgomery, Prince Georges, Washington, Worcester. NEW JERSEY. Atlantic, Burlington, Cape May: *Mackenzie* 6579; Mercer, Middlesex, Monmouth, Ocean, Somerset: *Mackenzie* 8382. NEW YORK. Bronx, Nassau: *Bicknell* 7625; Richmond, Suffolk, Westchester: *Bicknell* 7624. NORTH CAROLINA. Buncombe: *Standley and Bollman* 10252; Chowan: *Wiegand and Manning* 2786; Forsyth, Granville, Haywood, Madison, McDowell, Mitchell, Wayne. OHIO. Jackson. PENNSYLVANIA. Adams, Bedford, Berks, Bucks, Chester, Delaware, Franklin, Lancaster, Lehigh, Montgomery, Northampton, Philadelphia, Schuylkill, York. SOUTH CAROLINA. Anderson: *Davis* 7655, 8381, 8416; Berkeley, Florence: *Bartram* 2284; *Wiegand and Manning* 2787; Lexington. TENNESSEE. Cocke: *Ruth* 32, 120, 3353; Decatur, Sevier. VIRGINIA. Bedford, Craig, Fairfax, Fauquier, Gloucester, Isle of Wight: *Wiegand and Manning* 2784; Loudoun, Nansemond: *Heller* 930; Norfolk, Princess Anne, Roanoke, Shenandoah. WEST VIRGINIA. Fayette, Greenbrier, Hampshire, Monongalia, Preston, Wood.

48*b*. Subsp. **hispida** comb. nov.

S. integrifolia var. *hispida* Benth., Lab. Gen. et Sp. 435, 1833; type collected by Drummond (no. 248) at New Orleans (Kew).

S. integrifolia var. *major* Chapman, Fl. So. U. S. 323, 1887, based upon specimens collected by Chapman in Florida; the type is not certain.

S. ? polymorpha var. *teucrifolia* A. Hamilt., Ann. Soc. Linn. Lyon 1: 39, 1832.

Similar to subsp. *typica* but commonly larger, as tall as 60–70 cm., its stems *hispid in the lower parts* with spreading and often glandular hairs, these passing variously into the curled hairs of the upper part of the stem which are usually coarser than in subsp. *typica* and often sprinkled with capitate glands; basal leaves commonly deltoid or rhomboid, larger, as long as 3–4 cm., on longer petioles, usually crenate, *passing more gradually into the median leaves which are sometimes subcrenate, often tending to rhomboid*, 22–75 mm. long, averaging about 30–40 mm., 5–28 mm. broad, averaging about 10–15 mm., the internodes which they subtend averaging about 50 mm., both surfaces tending to be more hispid, especially toward the base of the plant; flowers commonly paniculate; calyces hispidulous with spreading hairs, glandular or eglandular; galea and tube 19–29 mm. long, the lower stamens seated 7–12 mm. above the base of the tube, the lower lip glabrous or pilose.

Distribution (see maps 23, 25).—Two well defined races occur, one in which the lower lip of the corolla is glabrous, the other in which it is clearly pilose in the center. *First race:* Florida. Alachua: Gainesville; Bradford: Hampton; Brevard: Indian River *Palmer* 390, 6607; Merritts Island; Duval: South Jacksonville *Curtiss* 2060, 4668, 5671, 6645; Pablo; Highlands: Istokpoga Prairie; Osceola: Kissimmee Prairie; Polk: Fort Meade; St. Johns: Hastings, Moultrie: *Correll and Correll* 8844; St. Augustine; St. Lucie: Fort Pierce; Volusia: De Land, Ormond. South Carolina. Dorchester: Summerville.

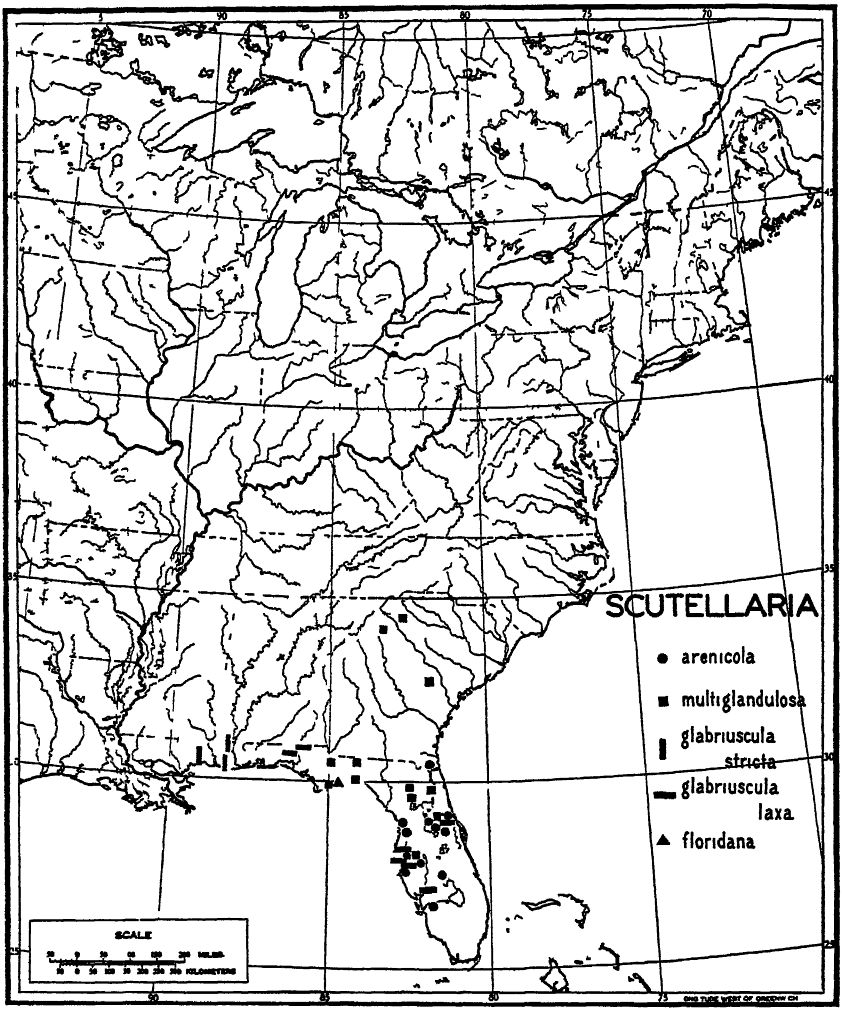
Second race: Alabama. Autauga: Baldwin; Conecuh: *Earle and Baker* 416; Dale: *Biltmore Herb.* 6091; Dallas: Marion Junction; DeKalb: Lookout Mountain; Lee: Auburn *Earle and Baker* 1190, 8701; Evergreen; Mobile: Mobile, Shelby; Tuscaloosa: Tuscaloosa. Arkansas. Hot Spring: Malvern *Palmer* 30342; Jefferson: Jefferson Springs, Pine Bluff *Eggert* in 1898; Miller: Doddridge *Palmer* 10522; Pulaski: Little Rock *Palmer* 22944. Florida. Escambia: Pensacola *Tracy* 8762; Gadsden: Quincy; Lake: Eustis; Lee: Pondilla; Leon: Tallahassee; Sarasota: Venice *Moldenke* 1034. Georgia. Chatham: Savannah; Clark: Athens; DeKalb: Stone Mountain *Eggert* in 1897; Floyd: Rome. Louisiana. Acadia: Crowley; Calcasieu: De Quincy; Jefferson Davis: Jennings *Palmer* 7604; Natchitoches: Chopin *Palmer* 7544; Rapides: Alexandria *Ball* 517; St. Landry: Chataignier; St. Tammany: Covington, Mandeville. Mississippi. Copiah: Crystal Springs; Harrison: Biloxi; Jackson: Ocean Springs *Skehan* 114, 1343; Noxubee: Macon; Oktibbeha: Starksville. North Carolina. Catawba: Hickory *Small and Heller* 272; Durham: Durham *Blomquist* 4789; Halifax: Enfield; Pasquotank: Elizabeth City *Wiegand and Manning* 2785. South Carolina. Anderson: Anderson; Berkeley: Mount Holly; Charleston: Charleston; Clarendon: Alcolu, Manning; Colleton: Walterboro; Lexington: Batesburg; Pickens: Central; Sumter: Cane Savannah. Tennessee. Carroll: Hollow Rock Jtn. *Svenson* 445; Chester: Henderson; Coffee; Tullahoma *Eggert* in 1897. Texas. Cass: Atlanta; Chambers: Anahuac; Hardin: Village Mills *Parks and Cory* 22134; Kountze; Harris: Angelina Bottom, Houston *Hall* 455; Jefferson: Beaumont; Montgomery: Conroe; Orange: Vidor; Smith: Swan; Tyler: Chester *Parks and Cory* 22133; Upshur: Big Sandy; Wood: *Reverchon* 2127. Virginia. Gloucester: Dutton, Gloucester; Norfolk: Norfolk.

49. **S. multiglandulosa** Small ex Harper, Bull. Torr. Bot. Club 27: 339, 1900.

S. integrifolia var. *multiglandulosa* Kearney, Bull. Torr. Bot. Club 21: 482, 1894; type collected by Nash (no. 1126) near Eustis, Lake County, Florida (U. S. Nat. Herb.).

A perennial herb 15–25 cm. tall, rarely 30 cm. or more, usually with one or two stems arising from a short rhizome, usually unbranched, the lower internodes closely covered with short spreading capitate glands and shorter spreading or sometimes retrorse hairs, the upper internodes spreading-pilose with slender capitate glands about .5 mm. long, and also pubescent with upwardly curled hairs similar to those of *S. hispida;* lowermost leaves usually obovate, entire or subcrenate, on petioles about as long as the blade, the median leaves *entire, sessile, prevailingly elliptical,* but generally broadest above the middle, 20–45 mm. long, averaging about 33 mm., 6–14 mm. broad, averaging about 9 mm., *the equivalent internode averaging about 23 mm., rarely longer than the leaf which subtends it,* both surfaces sparingly pilose with slender capitate hairs; flowering calyx viscid with spreading capitate glands, long and short, the lower lip 3 mm. at anthesis, 5–6 mm. long at maturity, the squama then 7.5–8.5 mm. in diameter; galea and tube 20–23 mm. long, the lower stamens seated 7.5–10 mm. above the base of the tube; nutlets dark brown, covered with thickish subimbricate squamellae.

S. multiglandulosa is unusually stable in habit, flower size, and pubescence, and is readily distinguished from *S. integrifolia* by the nature of the pubescence and the relation of the leaves to the internodes. The species apparently occupies two areas, one in Georgia lying parallel to the Savannah River, the second in northern Florida. Its distribution resembles that of *S. Altamaha,* but there is no appreciable morphologic differentiation of its two populations The corolla is apparently a light blue, with a markedly erose lip similar to that of *S. arenicola*. Texan forms of *S. integrifolia* may resemble *S. multiglandulosa* in habit, but not in pubescence.

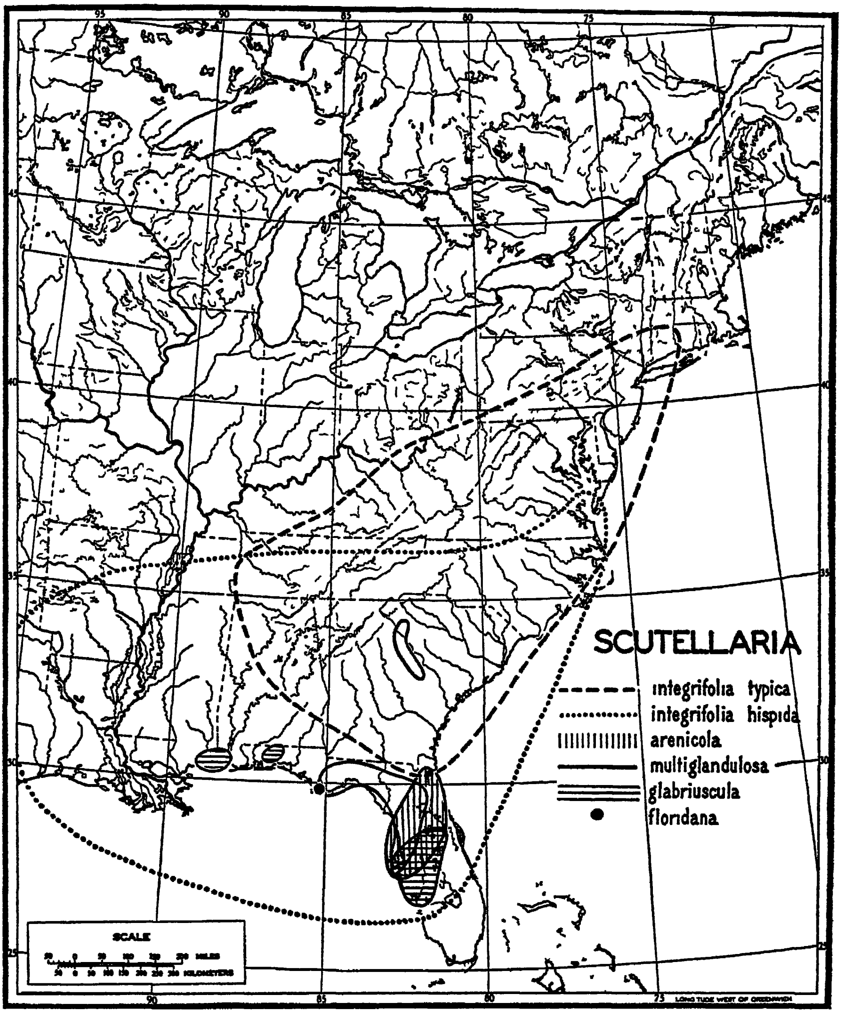


Map 24. Distribution of *S. arenicola, multiglandulosa, glabriuscula,* and *floridana.*

Distribution (see maps 24, 25).—FLORIDA. Alachua: Gainesville *Crawford; O'Neill* 481 (*S. integrifolia hispida* occurs here); Franklin: Apalachicola *Chapman* (with *S. integrifolia hispida* and *S. floridana*); Gadsden: Chattachoochee *Chapman;* Hillsborough: Tampa Bay, *Burrows* (with *S. arenicola*); Lake: Eustis *Nash* 1126 (occurs here with *S. arenicola*); Ocala *E. J. Palmer* 35176; Leon: Tallahassee *Berg;* Liberty: Bristol *Chapman* (*S. integrifolia hispida* occurs here), Marion: Blichton *Correll and Correll* 8880; Flemington *Moldenke* 1088 (*S. arenicola* occurs here); Putnam: Palatka *Williamson;* Suwannee: no locality *Hitchcock;* Wakulla: St. Marks *Rugel.* GEORGIA. Bulloch: dry pine barrens

Harper 822; Clarke: Oconee River at Athens *Harper* (occurs here with *S. integrifolia* subsp. *hispida*); Jefferson: Louisville *Hopkins;* McDuffie: near Thompson *Bartlett* 1037. SOUTH CAROLINA. Anderson: no locality *Gibbes.*

50. **S. glabriuscula** Fern., Bot. Gaz. 33: 156, 1902; type collected by A. H. Curtiss (no. 6907) near DeFuniak Springs, Florida (Gray Herb.).



Map 25. Limits of certain species of the section *Annulatae* (abstracted from maps 23, 24).

A perennial herb commonly 40–50 cm. tall, or more, rarely less than 30 cm., its stems slender, commonly branched in the inflorescence, *thinly puberulent throughout with small, upwardly curved, appressed hairs,* often with a few spreading bristles in the lowermost nodes, frequently with a few short capitate glands in the uppermost parts; lowermost leaves soon deciduous, on slender petioles as long as the blades or longer, few-toothed, ovate or elliptical, soon passing into entire median leaves which are prevailingly elliptical, even sublinear, 2–5 cm. long, averaging about 33 mm., *3–14 mm. broad, averaging about 7 mm.,* all *glabrate* or entirely glabrous, the uppermost gradually diminished, linear; petioles usually 5–6 mm. long; flowering calyces *puberulent with small, upwardly curved, appressed hairs,* less often with spreading capitate glands in addition; the lower lip 3–3.5 mm. long at anthesis, somewhat larger at maturity, the squama then about 7 mm. in diameter; galea and tube 18–27 mm. long, the lower stamens seated 8–11 mm. (usually 9.5 mm.) above the base; nutlets apparently black, covered with thickish subimbricate squamellae.

50*a*. Subsp. **laxa** nom. nov., based upon *A. H. Curtiss* 6907.

Stems lax, tending to be decumbent at the base, the leaves lax and tending to spread; lower lip of the corolla *glabrous.*

Except for differences in habit that are due especially to the broader leaves, this is hard to distinguish from *S. floridana,* which occurs only at Apalachicola. A specimen in fruit, collected by Small on Little Stone Mountain, DeKalb County, Georgia, is possibly referable here.

Distribution (see maps 24, 25).—FLORIDA. Hillsborough: Tampa Bay *"U. S. D. A.";* Holmes: Westville *Curtiss;* Lee: Alva *Hitchcock* 278; Manatee: Bradenton *Tracy* 6625, 6898; Orange: Sanford *Nash* 2277; Sarasota: 8 miles southeast of Venice *Moldenke* 1034; Seminole: 7 miles below Sanford *Williams;* Walton: De Funiak Springs *Curtiss* 2060, 6907.

50*b*. Subsp. **stricta** subsp. nov.; type collected by Skehan (no. 113) near Ocean Springs, Mississippi (Gray Herb.).

Strictior foliis ascendentibus; corollarum labia inferiore *pilosa.*

Distribution (see maps 24, 25).—ALABAMA. Conecuh: Evergreen *Earle and Baker;* Mobile: Delchamps *Graves* 682; Mobile *Mohr;* Spring Hill *Drushel* 4593; Theodore *Munz* 1325. FLORIDA. Escambia: Pensacola *Blanton* 6568. MISSISSIPPI. Harrison: Biloxi *Tracy* 4453; *Munz* 1326; *Tracy and Lloyd* 576; Jackson: Ocean Springs *Tracy* 4900; *Skehan* 113, 1343.

51. **S. floridana** Chapman, Fl. South. U. S. 324, 1887; authentic material collected by Chapman at Apalachicola, Florida, is widely distributed.

A perennial herb 30–40 cm. tall, *glabrate throughout,* the lowermost internodes *sparingly hispidulous with minute conical hairs,* the upper hirtellous with minute, upwardly curved hairs and sprinkled with large sessile glands; leaves uniform throughout, linear, 2–4 cm. long, *1.5–2.5 mm. broad,* entire, sessile, ascendent, rarely longer than the internodes, rarely less than half as long; flowers in the axils of the upper much diminished leaves; calyx hirtellous with *small, upwardly curled, appressed hairs,* and densely beset with sessile glands, the lower lip 4.5–5 mm. long at anthesis, 7 mm. long at maturity, thickish and venose, the squama then about 7 mm. tall; corolla blue, its tube and galea 24–26 mm. long, the lower stamens attached about 8 mm. above the base of the tube, the lower lip glabrous, 15 mm. in diameter, the galea cymbiform, 5–6 mm. wide when flattened sidewise, glabrous within; nutlets not seen at maturity, apparently closely papillate.

This species is similar to *S. glabriuscula* subsp. *laxa,* being distinguished chiefly by the narrower leaves.

Distribution (see maps 23, 24).—Grows only at Apalachicola, Florida: *Moldenke* 1147; *Small, De Winkeler,* and *Mosier* 11244; *Deam.*

SECTION VIII. **Uliginosae**

Uliginosae Epl., Lilloa 4: 232, 1939.

Subsect. *Uliginosae* Epl., Rept. Spec. Nov. 85: 173, 1936. The type species is *S. purpurascens.*

Herbs, mostly less than a half meter tall, falling into two series with respect to habit: the first, low, usually with several unbranched stems arising from a

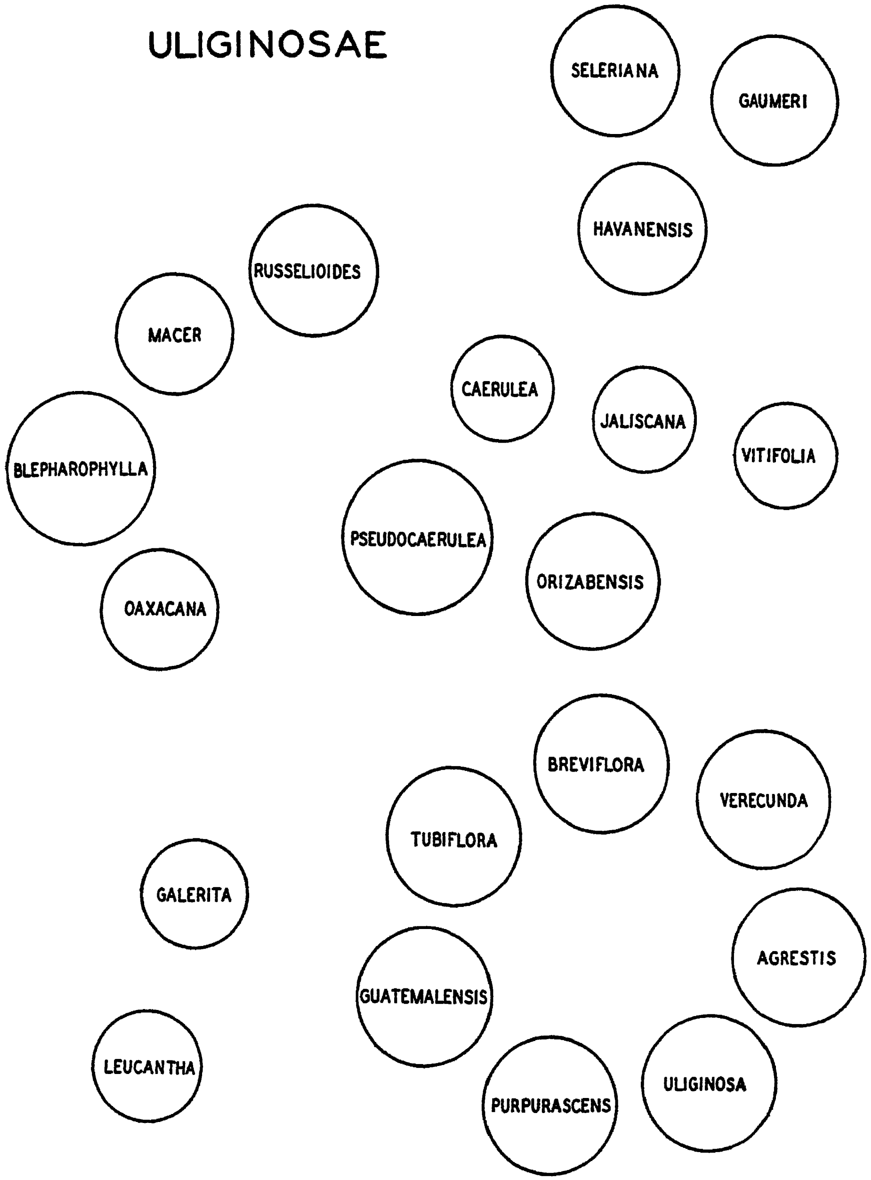


Fig. 10. Possible relationships within the section *Uliginosae*.

short rhizome and a fascicle of thickish, even fusiform roots; the second, often taller, but lax and apparently often procumbent, seemingly with more elongate rhizomes and usually branched in the upper parts. The internodes are usually elongate and longer than the leaf blade and petiole which subtend them. Leaves ovate, thinly hirsute above with rather stout jointed hairs, hirtellous along the veins beneath, especially in the first series, but usually evenly pubescent with small straight hairs on both surfaces in the second series. Racemes 5–10 cm. long, or less, the flowers usually not strictly opposite, often subverticillate, subtended by persistent or tardily deciduous bracts, but sometimes genuinely opposite in the axils of the upper diminished leaves. Corolla mostly dark violet, sometimes whitish, the tube slender, straight, pilose within toward the base, sometimes densely so, but not sharply annulate, the lip glabrous. Nutlets papillose and black, so far as known. Species of the New World tropics.

The variability within this section suggests that it originated in part from two such diverse groups as *Galericularia* and *Speciosae*.

The species of this section are unusually difficult to study in the herbarium, being meagerly represented. In flower structure and size they present less variation than may sometimes be found within a single species. As they are mostly similar in pubescence and habit of foliage, they are distinguished chiefly by accumulations of small habital differences. Suggested relationships are shown in figure 10.

KEY TO THE SPECIES

A. Corolla tube and galea 6.5–8 mm. long over all, the lower stamens attached about 2.5 mm. above the base of the tube; otherwise similar to *S. purpurascens*....52. **S. agrestis**

AA. Corolla tube and galea rarely less than 12 mm. long, the stamens attached about 6:5 mm. above the base of the tube or more.

B. Median petioles 10–20 mm. long or more, rarely less (see also *S. verecunda* and *S. Seleriana*).

C. Pubescence of stems minute, spreading or curled, clearly much smaller than the hairs on the upper surface of the leaves, sometimes with longer spreading hairs in the inflorescence.

D. Galea and tube of corolla 12–15 mm. long, the lower stamens attached 6.5–8 mm. above the base of the tube.

E. Corolla white or pallid; median leaves tending to oblong, but cordate at the base, 4–6 cm. broad; plants of eastern Peru...59. **S. leucantha**

EE. Corolla purple (or ?rose), not pallid; median leaves ovate, rarely as much as 4 cm. wide.

F. Leaf blades 4–8 cm. long, cordate at the base; plants of Brazil, Paraguay, and eastern Bolivia...............56. **S. uliginosa**

FF. Leaf blades commonly 2.5–5 cm. long, rounded but hardly subcordate at the base.

G. Erect plants, their leaves rather narrowly ovate, acuminate; Andean plants from Venezuela to Argentina ....54. **S. breviflora**

GG. Decumbent spreading plants with broadly ovate, often obtuse leaves.

H. Plants of northern Colombia........55. **S. verecunda**

HH. Plants of the Caribbean.........53. **S. purpurascens**

DD. Galea and tube of corolla 20–26 mm. long, the lower stamens attached 11–12 mm. above the base of the tube.

E. Hairs of the upper part of the stem short and conical, spreading.

F. Petioles 1–2 cm. long; median leaf blades 2.5–3.5 cm. long; plants of central Brazil......................57. **S. tubiflora**

FF. Petioles 3–5 cm. long; median leaf blades 7–8 cm. long; plants of Mexico...............................63. **S. vitifolia**

EE. Hairs of the stem curled, a few longer spreading hairs in the inflorescence; plants of Mexico..................61. **S. orizabensis**

CC. Pubescence of stems relatively coarse throughout, the hairs comparable to those on the upper surfaces of the leaves; plants of Mexico, Central America, and the West Indies.

D. Corolla and galea 18–23 mm. long, the lower stamens attached 11–13 mm. above the base of the tube.

E. Hairs curled downward along the stem, chiefly on alternate faces or along the angles; pedicels twice the length of the calyces, the flowers axillary in the upper parts of the plant........................64. **S. jaliscana**

EE. Hairs spreading throughout, or somewhat retrorse, the median parts of the stem with smaller decurved hairs; pedicels equaling the calyces, the flowers opposite in racemes 5–20 cm. long.........62. **S. pseudocaerulea**

DD. Corolla tube 15–16 mm. long, the lower stamens attached 7–8 mm. above the base; hairs of stem spreading and more or less capitate-glandular; petioles 30–50 mm. long....................................60. **S. galerita**

BB. Petioles of median leaves mostly 3–8 mm. long, the longest rarely 10–12 mm.

C. Plants of the Caribbean islands and southern Florida, rarely of the Mexican mainland, their leaves rarely 10 mm. or more long; pubescence diverse, but mostly minute..70. **S. havanensis**

CC. Plants of the mainland, chiefly Mexican, some Guatemalan.

D. Flowers in the axils of slightly reduced leaves (see also *S. caerulea*); hairs of stem ascendent, or if somewhat spreading, curled upward at the tip, coarse, and similar to those of the upper surfaces of the leaves.

E. Foliage glabrous or nearly so; plants of Orizaba...........69. **S. macer**

EE. Foliage pubescent on both surfaces; plants of Sinaloa..68. **S. russelioides**

DD. Flowers racemose, bracteate; hairs of stem directed downward, or if spreading, either straight or curled downward at the tip, not at all ascendent.

E. Hairs strictly along angles of stems only, sometimes nearly wanting; leaves tending to rhomboid, cuneate at the base; flowers in diffuse racemes or subaxillary, usually 1–2 cm. apart or more...........65. **S. caerulea**

EE. Hairs equally distributed on the stems, dense; leaves tending to rotund or ovate rather than rhomboid, generally rounded or truncate at the base; flowers in crowded racemes, usually 1 cm. apart or less.

F. Stems predominantly simple, the racemes terminal.

G. Hairs of stem mostly uniform and curled downward; median leaf blades 1.5–2 cm. long; galea and tube of corolla about 17 mm. long.................................66. **S. oaxacana**

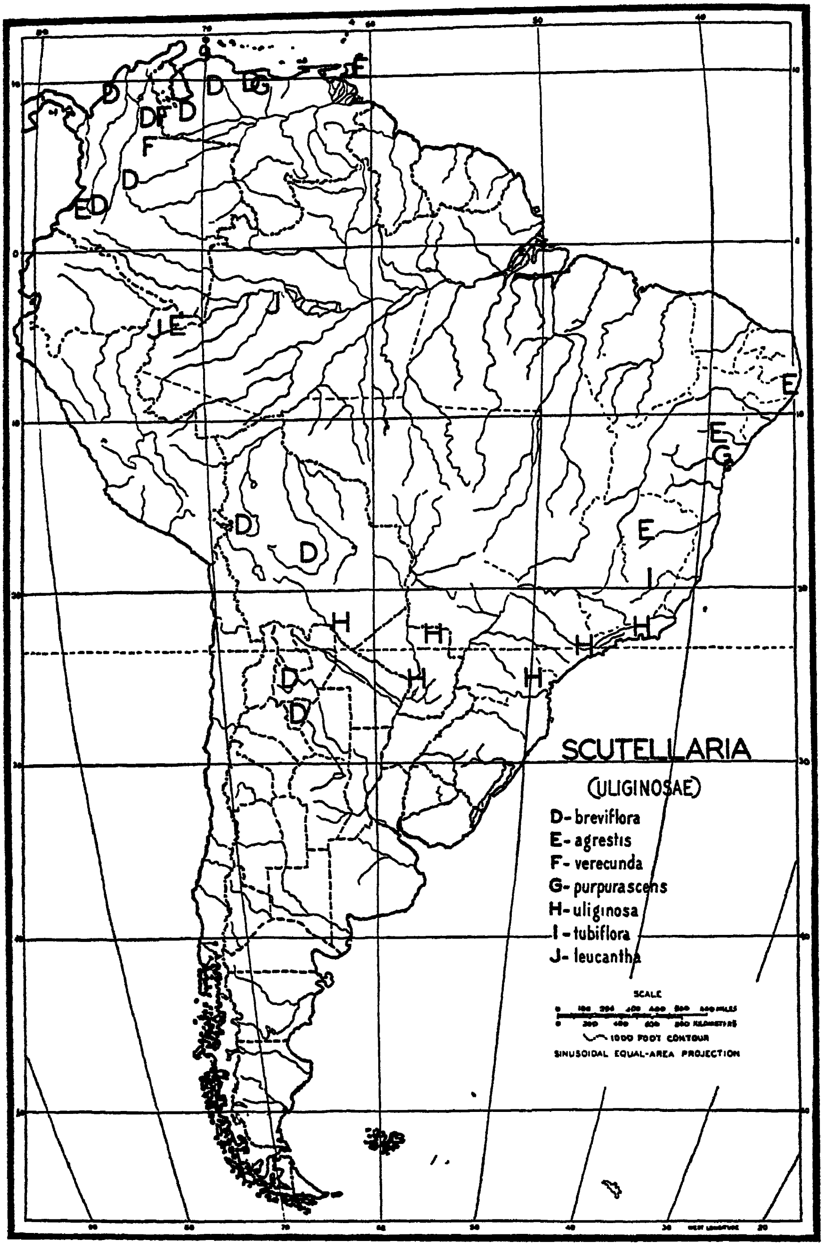
GG. Hairs of stem of two sorts, smaller hairs which are decurved, and longer coarser hairs which, while directed downward, tend to spread; median leaf blades 3–3.5 cm. long; galea and tube of corolla 19–21 mm. long................67. **S. blepharophylla**

GGG. Hairs of stem spreading, straight and sharp, of varied length; median leaf blades 2–4 cm. long; galea and tube of corolla 13–14 mm. long.........................58. **S. guatemalensis**

FF. Stems clearly branching in the upper parts, the plants often twiggy, often decumbent, the racemes commonly axillary and often crowded at the tips of the branches; lower surfaces of leaves rather evenly hirsute with straight hairs.

G. Galea and tube of corolla 12–15 mm. long, the lower stamens attached 5.5–7.5 mm. above the base of the tube; plants of Yucatan (see also *S. havanensis*).............71. **S. Gaumeri**

GG. Galea and tube of corolla 14–20 mm. long, the lower stamens attached 8.5–11.5 mm. above the base of the tube; plants of central Mexico and Guatemala..................72. **S. Seleriana**



Map 26. Distribution in South America of certain species of section *Uliginosae*.

52. S. agrestis St. Hil. ex Benth., Lab. Gen. et Sp. 427, 1834; type collected by St. Hilaire (no. 1494) near San Miguel da Jequitinhonha, Minas Geraes, Brazil (Paris).

A small herb probably perennial, branching at the base and more or less procumbent, its roots thickish, fascicled, its stems 15–25 cm. tall, puberulent with short spreading hairs; leaf blades 2–3.5 cm. in diameter, rotund-cordate, obtuse at the apex, their margins sinuate-dentate, the upper surface nearly glabrous, sprinkled with a few appressed hairs, puberulent on the veins beneath and usually purplish; petioles 8–12 mm. long; racemes usually 3–4 cm. long; flowers subopposite, sometimes 3 or 4 in the axils of persistent, spatulate bracts; pedicels about 2 mm. long; flowering calyces about 1.5 mm. long, hirtellous, the lower lip 4–4.5 mm. long at maturity, the scutellum then about 5 mm. tall; corolla blue, its tube and galea about 6.5–8 mm. long, the lower stamens seated about 2.5 mm. above the base of the tube; nutlets not seen.

This diminutive species, easily confused with *S. purpurascens,* is distinguished chiefly by the small flowers. It is little known, however, and may represent only a phase of that species.

Distribution (see map 26).—TRINIDAD. No locality *Sieber* 169 (not since collected so far as known).

BRAZIL. MINAS GERAES. San Miguel da Jequitinhonha *St. Hilaire* 1494. BAHIA. Jacobina *Blanchet* 1729, 3538. PERNAMBUCO. Tapera *Pickel* 2422.

ECUADOR. MANABI. El Recreo ½° S. *Eggers* 15599.

PERU. LORETO. Rio Huallaga *Williams* 4497; Rio Nanay *Williams* 446; San Salvador on Rio Amazona *Williams* 1556.

53. **S. purpurascens** Sw., Prodr. 89, 1788; type collected by du Ponthieu on Guadeloupe (Brit. Mus.).

S. Felisberti Nees et Mart., Nov. Act. Nat. Cur. 11: 77, 1823; type collected in Bahia (Munich).

S. ? malvaefolia Kunth, *in* Humboldt and Bonpland, Voy., Nov. Gen. et Sp. Pl. 2: 324, 1817; type collected by Bonpland in Colombia near the Santa Anna Mine (apparently lost).

? Perilomia malvaefolia Briq., *in* Engler u. Prantl, Nat. Pflanzenf. 4, 3a: 233, 1897.

A small herb 15–40 cm. tall usually with several stems arising from a small caudex, these either ascendent or somewhat decumbent, clothed evenly throughout with minute and spreading but somewhat downwardly curled hairs; leaf blades deltoid-ovate or broadly ovate, the median commonly 3–4 or even 6 cm. long, infrequently less, commonly about half as long as the corresponding internode, obtuse, acute or acuminate at the apex, rounded at the base or truncate, rarely subcordate, their margins rather coarsely sinuate-dentate, the upper surfaces thinly clothed with rather coarse, jointed hairs, sometimes glabrate, the lower glabrous except on the veins, where they are appressed-hirtellous; flowers in racemes, mostly 3–8 cm. long; calyces minutely and sparingly hirtellous with ascendent hairs; galea and tube of the corolla 13–15 mm. long, the lower stamens seated 7–8 mm. above the base of the tube; nutlets not seen.

The foregoing description applies to the plants in the Caribbean islands, Costa Rica, and Panama. In South America, the plants are somewhat smaller, with smaller flowers. There are, however, at least two other closely allied forms in South America: *S. verecunda* Epl., described from Colombia, and *S. breviflora* Benth., originally described from Peru but ranging throughout most of the Andes. The relationship of these to *S. purpurascens* is obscure. *S. verecunda* appears to be a taller more lax herb with smaller subentire leaves. The pubescence and flowers are about the same as those of *S. purpurascens. S. breviflora* has a strict habit, the leaves are almost always acute or acuminate, the petioles appear proportionately shorter and bear a different relationship to the internode. Some of the plants of Costa Rica referred here to *S. purpurascens* seem scarcely different. A form occurs in Panama with clearly cordate and more oblong leaves. The data are too meager for satisfactory analysis.

Distribution (see maps 26, 27).—ANTILLES. GUADELOUPE. *Duss* 2163. MARTINIQUE. *Andre* 65; *Hahn* 107; *Duss* 1220, 1974, 2163. SANTA LUCIA. *Walsh.* ST. VINCENT. Sanfriere *Lloyd* 480; *Smith and Smith* 976.

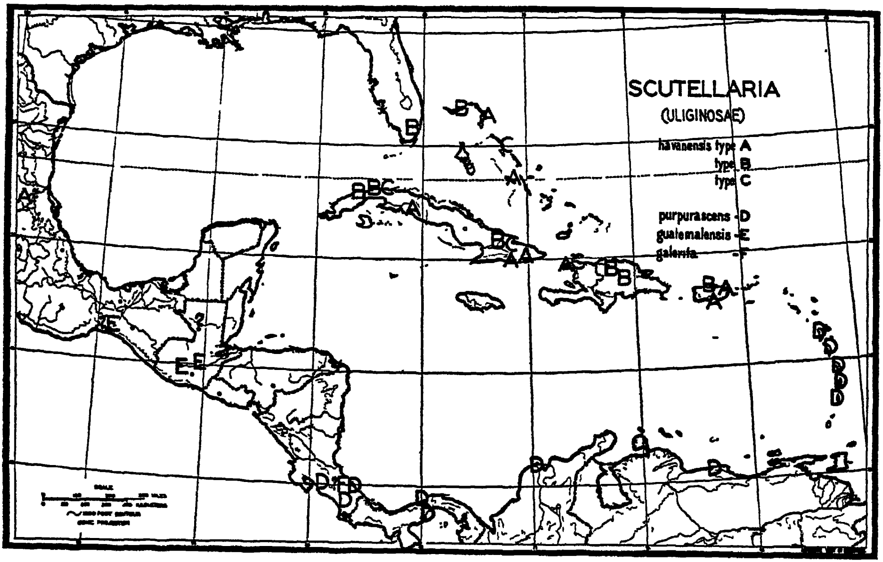
Costa Rica. La Uruca *Biolley* 930; Rio Chiriqui *Pittier* 21; La Uruca, near San Jose *Pittier* 331; Rio Tiliri at San Jose *Tonduz* 426, 1426, 8773; Talamanca *Tonduz* 9549; Finca Las Concavas, Cartago *Standley* 41429; San Jose *Standley* 41204; Dulce Nombre, Cartago *Standley* 35863; Cerro de Carpentera, Cartago *Standley* 35491; Barrio Lujan, San Jose *Standley* 34822; La Verbena, San Jose *Standley* 32209; Near Limon *Pittier* 16013; La Verbena, near Alajuelita *Tonduz* 8784.

Panama. Cana *Williams* 764, 949; Fort Sherman, Canal Zone *Standley* 31095; Sibubi Falls, Sixola Valley *Rowlee and Rowlee* 378; between Frijoles and Monte Serio *Killip* 12162; Garden of Gatun Station *Hayes* 59.

Colombia. Balsapamba *Andre* 4049.

Venezuela. Colonia Tovar *Fendler* 871; La Victoria *Preuss* 1605; Caracas *Pittier* 7199, 7873; Caracas *Kuntze* 1225; Caracas *Funck* 302.

Brazil. Bahia, Lago Almada *Martius;* Rio de Janeiro, Novo Friburgo *Glaziou* 14195.



Map 27. Distribution of Caribbean species of section *Uliginosae.*

54. **S. breviflora** Benth., *in* Lindl. Bot. Reg. 18, pl. 1493, 1832; probable type collected by Pavon in Peru, in herb. Univ. Oxf.

A perennial herb 20–40 cm. tall, with thickened fascicled roots, the stems puberulent with small spreading hairs; leaf blades 2.5–6 cm. long, 1.5–3.5 cm. broad, ovate, acute at the apex or acuminate, especially the uppermost rounded or rounded-truncate at the base, sometimes subcuneate, scarcely cordate, sinuate-dentate on the margins, the upper surface sparingly sprinkled with appressed jointed hairs, nearly glabrous, the lower very shortly puberulent along the veins; petioles 8–20 mm. long; racemes prevailingly 5–10 cm. long, the flowers usually subopposite, sometimes 3 in a verticil, subtended by persistent spatulate bracts 2–4 mm. long; pedicels 3–4 mm. long; flowering calyces 2–2.5 mm. long, sparingly hirtellous, the lower lip 5 mm. long at maturity, the scutellum about 4 mm. tall; corolla violescent, the tube and galea 13–15 mm. long, the former hirtellous within; nutlets black, acutely mammillate.

In the Andes this species is readily distinguished from *S. purpurascens* by the habit of its leaves and its more strict appearance. In Costa Rica, however, forms may be found which are frequently as referable to one as to the other.

Distribution (see map 26).—Venezuela. Barquisimeto *Funck and Schlim* 773; Andes of Trujillo and Merida *Linden* 490; Merida *Moritz* 989; Rincon del Diablo, Carabobo *Pittier* 7973; Galipan, Caracas *Funck* 737.

Colombia. Ocana *Engels;* Magdalena, Muica *H. H. Smith* 1372; Cundinamarca, Fusagasuga to Pandi *Pennell* 2745; Cundinamarca, Caqueza *Pennell* 1892; Boqueroa del Dagua *Lehmann* 5829; El Patico, Rio Paez *Lehmann* 6093; Ocana to Pamplona *Kahlbreyer* 1075.

Bolivia. Santa Cruz, Boa Vista *Steinbach* 7283, 7489; Prov. Chiquitos *Weddell* 3432; Rio Palometillas, Santa Cruz *Steinbach* 6759; Yungas *Bang* 358; Polo-Polo near Coroico, Nordyungas *Buchtien* 5880; Milluguaya, Nordyungas *Buchtien* 4689; La Florida near Yanacachi, Sud Yungas *Buchtien* 270, 324; Yungas de San Mateo, Comarapa, Santa Cruz *Steinbach* 8408.

55. **S. verecunda** Epl., Rept. Spec. Nov. *85: 173, 1936;* type collected by Killip and Smith (no. 20751) between Pamplonita and Chinacota, Norte de Santander, Colombia (U. S. Natl. Herb.).

A perennial herb, apparently procumbent at the base, its stems slender, branching, 20–40 cm. tall, puberulent with small spreading hairs; leaf blades ovate, 12–25 mm. long, 10–23 mm. broad, obtuse at the apex or shortly acuminate, rounded at the base, the margins rather convex and subentire, the upper surface nearly glabrous, sprinkled with a few appressed hairs, the lower puberulent along the veins; petioles 5–12 mm. long; flowers opposite in the axils of subspatulate tardily deciduous bracts; flowering calyces nearly glabrous, 2.5–3 mm. long, the lower lip 4–4.5 mm. long at maturity, the scutellum 3–4 mm. tall; corolla violescent, the galea and tube 12–15 mm. long; nutlets black, verrucose.

This species seems intermediate with *S. breviflora* and *S. purpurascens.* The several species allied here, *S. agrestis, S. uliginosa, S. breviflora,* and *S. purpurascens,* are separable chiefly by modal associations of habit differences, and are not easy to distinguish by words, although each has a characteristic and recognizable habit within its range.

Distribution (see map 26).—Colombia. Norte de Santander. Between Pamplonita and Chinacota *Killip and Smith* 20751. Santander. Rio Lebrija near Bucaramanga *Killip and Smith* 16313.

56. **S. uliginosa** St. Hilaire ex Benth., Lab. Gen. et Sp. 427, 1834; type collected by St. Hilaire (no. 1641) in Sao Paulo, Brazil (Paris).

A perennial herb with thickened fascicled roots, its stems 30–50 cm. tall, puberulent with small spreading hairs; leaf blades 4–8 cm. long, broadly ovate, the upper frequently rotund, rather acute or obtuse at the apex, cordate at the base, particularly the lower leaf blades, sinuate-dentate, the upper surface nearly glabrous, sprinkled with appressed jointed hairs, the lower surface puberulent on the veins with short hairs; petioles 10–25 mm. long; racemes 5–12 cm. long, the flowers partly opposite, sometimes three or four in false whorls, sometimes solitary in the axils of small leaflike bracts 3–8 mm. long; pedicels 3.5 mm. long; flowering calyces 3–3.5 mm. long, hispidulous, the lower lip 4.5–5 mm. long at maturity, the scutellum 5 mm. tall; corolla pale blue, the galea and tube 13–15 mm. long; nutlets black, acutely mammillate.

Distribution (see map 26).—Bolivia. Gran Chaco near Tatarenda *Fries* 1503; *D'Orbigny* 1096.

Brazil. Corrego Alegre, Sao Paulo *Löfgren;* Sao Paulo *St. Hilaire* 1641; Rio de Janeiro *Schott;* Alexandra to Serra da Prata, Parana *Dusen* 10278.

Paraguay. Estancia Santa Maria *Anisits* 2589; Rio Apa to Rio Aquidaban *Fiebrig* 4093; Papricay *Hassler* 1553; Luque to d'Aregua *Balansa* 988a; Pirayubi *Balansa* 988; Concepcion *Hassler* 7432.

57. **S. tubiflora** Benth., *in* Lindl. Bot. Reg. 18, 1493, 1832; and Lab. Gen. et Sp. 427, 1834; type collected by Sellow on the Rio Fulda, Minas Geraes, Brazil (Berlin).

A perennial herb 20–40 cm. tall, branching at the base, the stems cinereous in the upper parts with short spreading hairs; leaf blades ovate, 2.5–3.5 cm. long, usually obtuse at the apex, rounded at the base or cuneate, the margins rather convex, sinuate-dentate, the upper surface sprinkled with appressed jointed hairs, the lower hispidulous, especially along the veins; petioles 1–2 cm. long; racemes 3–5 cm. long, the flowers subopposite, disposed in the axils of ovate hispidulous tardily deciduous bracts; flowering calyces 3 mm. long, hispidulous, not seen at maturity; corolla apparently violet, its tube slender, 15–23 mm. long, sparingly hirtellous; nutlets not seen.

Distribution (see map 26).—Known only from the type collection.

58. **S. guatemalensis** Leon., Contrib. U. S. Natl. Herb. 22: 715, 1927; type collected by Türckheim (no. 1196) near Santa Rosa, Baja Verapaz, Guatemala (U. S. Natl. Herb.).

S. purpurascens var. *heterophylla* Benth., DC. Prodr. 12: 416, 1848; type collected by Friederickstal in Guatemala (Kew).

A perennial herb 15–40 cm. tall, its stems prevailingly simple, clothed throughout with straight sharp spreading hairs; leaf blades ovate, the median 1.5–4.5 cm. long, borne on petioles 3–12 mm. long, obtuse or shortly acuminate at the apex, rounded or even subcordate at the base, their margins crenate, both surfaces evenly clothed with straight hairs; flowers in terminal racemes commonly 3–5 cm. long; flowering calyces 3 mm. long, clothed like the stems; corolla tube and galea 13–14 mm. long, the lower stamens seated 8.5–9 mm. above the base of the tube; nutlets fuscous, roughly tuberculate.

This species is similar in habit to *S. breviflora,* differing chiefly in pubescence; it also suggests *S. tubiflora* of Brazil.

Distribution (see map 27).—GUATEMALA. BAJA VERAPAZ. Santa Rosa *Türckheim* 1196, 3123.

MEXICO. CHIAPAS. Unstated locality *Ghiesbreght* 803.

59. **S. leucantha** Loesen., Verhandl. Bot. Ver. Prov. Brandenb. 47: 187, 1905; type collected by Ule (no. 5930) on the Rio Jurua near Fortaleza, Amazonas, Brazil (Berlin).

A perennial herb with thickened fascicled roots, its stems 20–30 cm. tall, glandular-hispidulous in the upper parts; leaf blades narrowly ovate, 7–12 cm. long, 2.5–6 cm. broad, rather obtuse at the apex, subcordate at the base or plainly cordate, the margins coarsely sinuate-dentate, ciliolate, the upper surface sparingly sprinkled with rather stiffish jointed hairs, the lower hirtellous along the veins; petioles 2–3.5 cm. long; racemes glandular, simple, 3–10 cm. long, the flowers subtended by tardily deciduous ovate-lanceolate bracts; pedicels 4–5 mm. long; flowering calyces 2 mm. long, hirtellous, not seen at maturity; corolla tube and galea 15 mm. long, the former white, the latter pale rose or violet; nutlets not seen.

Distribution (see map 26).—PERU. LORETO. Soledad on Rio Itaya *Killip and Smith* 29772; San Antonio, Rio Itaya *Killip and Smith* 29349, 29501; Alto Rio Itaya *Williams* 3390.

BRAZIL. AMAZONAS. Rio Jurua near Fortaleza *Ule* 5930.

ECUADOR. Rio Bomboiza *von Hagen* 54.

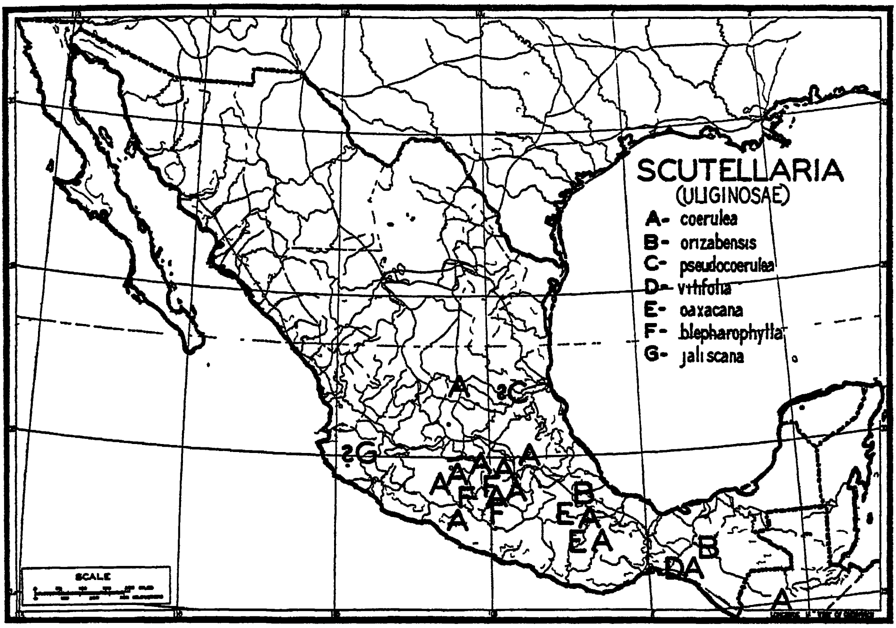
60. **S. galerita** Epl., Lilloa 4: 239, 1939; type collected by J. D. Smith (no. 6701) near Suerre, district of Santa Clara, Costa Rica (U. S. Natl. Herb.).

A perennial herb 25–30 cm. tall, its stems densely clothed with rather stout spreading hairs and capitate-glandular in the inflorescence; leaf blades 5–9 cm. long, ovate-cordate, the margins irregularly sinuate-crenate, the upper surface sprinkled with rather stout jointed hairs, the lower hispidulous along the veins; petioles 3–5 cm. long; flowers in crowded glandular racemes 8–10 cm. long, subtended by persistent lanceolate bracts; flowering calyces 3 mm. long, the lower lip somewhat longer at maturity, the scutellum 5–6 mm. tall; corolla (?) white, the tube and galea 15 mm. long, the lower stamens seated 7.5 mm. above the base of the tube; nutlets not seen.

Distribution (see map 27).—Known only from the type locality *J. D. Smith* 6701.

61. **S. orizabensis** Epl., Lilloa 4: 239, 1939; type collected by F. Müller (no. 3024) in the Sierra de Uluapa, Orizaba, Mexico (N. Y. Bot. Gard.).

A perennial herb 20–40 cm. tall, its stems puberulent with small curled hairs and sprinkled with longer spreading hairs in the inflorescence; median leaf blades ovate or subrotund, 2.5–4.5 cm. long, usually obtuse at the apex, usually nicely cordate at the base, the margins crenate, the upper surface sparingly sprinkled with rather stout hairs, the lower hirtellous, chiefly on the veins; petioles 2–2.5, rarely 1 cm. long, about half as long as the subtended internode; flowers in racemes 3–8 cm. long; flowering calyces hirtellous with short ascendent hairs, scarcely 3 mm. long, the lower lip 5 mm. long at maturity; corolla violet, the galea and tube 20–21 mm. long; lower stamens seated 11–12 mm. above the base of the tube; nutlets not seen.



Map 28. Distribution of Central American species of section *Uliginosae*.

Distribution (see map 28).—MEXICO. VERA CRUZ. Huatusco *Mohr;* Engenio, Sierra de Uluapa, Orizaba *F. Muller* 1599, 3024; Orizaba *Bourgeau* 2776; *Botteri* 319; *Seaton* 143; Orizaba, 4500 feet *Rowntree* 103; *Chiapas,* Mount Ovando *Matuda* 147a (so labeled, but Matuda also collected in Vera Cruz).

62. **S. pseudocaerulea** Briq., Ann. Conserv. Gen. 4: 240, 1900; type collected by Pringle (no. 3068) near Las Canoas, San Luis Potosi, Mexico (Deless.).

A perennial herb 40–50 cm. tall, its stems evenly clothed throughout with spreading or somewhat decurved hairs similar to those on the upper surfaces of the leaves and usually with shorter ones as well; median leaf blades 5–7 cm. long, ovate or deltoid-ovate, mostly acute, rounded at the base or somewhat truncate, crenate, the upper surfaces evenly but thinly sprinkled with jointed hairs, the lower hirtellous along the veins, borne on petioles 1.5–3 cm. long, about a third the length of the internode; flowers in racemes 5–20 cm. long; calyces thinly sprinkled with long and short ascendent hairs; galea and tube 18–19 mm. long, the lower stamens seated 9–11 mm. above the base; nutlets not seen.

A specimen recently collected by Gentry in pine forests at 6000–7000 feet elevation at Ocurahui, Sierra Surotato, Sinaloa, is allied to the above and may represent another species.

Distribution (see map 28).—Known only from the type locality.

63. **S. vitifolia** Brandegee, Univ. Calif. Publ. Bot. 10: 415, 1924; type collected by Purpus (no. 9207) near Jalisco, Chiapas, Mexico (Univ. Calif., Berk.).

A perennial herb 25–30 cm. tall, its stem closely puberulent in the lower parts with small, downwardly curled hairs, the inflorescence with spreading sharp hairs of varied length; leaf blades rotund-cordate, the largest 7–8 cm. long, borne on petioles 3–5 cm. long, these equaling or longer than the corresponding internodes, their margins irregularly dentate, the upper surfaces sparingly sprinkled with rather coarse hairs, the veins beneath hirtellous; flowers crowded in racemes about 5 cm. long; calyces sparingly hirtellous with upwardly curled hairs; galea and tube (?white) 22–23 mm. long, the lower stamens seated about 15 mm. above the base of the tube; mature nutlets not seen.

Distribution (see map 28).—Known only from the type locality.

64. **S. jaliscana** Epl., Lilloa 4: 242, 1939; type collected by Diguet in Jalisco, Mexico, no stated locality (N. Y. Bot. Gard.).

A perennial herb as much as 65 cm. tall, its stems apparently ascending from a short caudex, villous throughout with rather long but not rigid hairs, especially along the angles; leaf blades gradually diminished upwards, the lower 4–4.5 cm. long, nicely deltoid-cordate, borne on petioles 2–2.5 cm. long, the upper ovate, borne on petioles 3–4 mm. long, the margins of all crenate, both surfaces sprinkled with rather coarse hairs; flowers solitary in the axils of the uppermost leaves; pedicels slender, 10–12 mm. long; calyces sparingly clothed with rather long hairs; galea and tube of the corolla 22–23 mm. long, the lower stamens seated 12–13 mm. above the base of the tube; nutlets not seen.

Distribution (see map 28).—Known only from the type locality.

65. **S. caerulea** Moc. et Sessé ex Benth., *in* Lindl. Bot. Reg. 18, pl. 1493, 1832, based upon specimens collected by Mociño and Sessé in Mexico; probable type in herb. of Oxford Univ., authentic material in Madrid Herb.

S. dumetorum Schlecht., Linnaea 7: 400, 1832; type collected by Schiede between San Miguel del Soldado and La Joya, Vera Cruz, Mexico (Berlin).

S. distans Fern., Proc. Am. Acad. 35: 562, 1900; type collected by Rose (no. 2951) near Bolanos, Jalisco (U. S. Natl. Herb.).

S. chalicophila Loesen., Bull. Herb. Boiss. 7: 569, 1899; type collected by Seler (no. 2324) in Huehuetenango, Guatemala (Berlin).

S. affinis Leon., Contrib. U. S. Natl. Herb. 22: 741, 1927; type collected by Ghiesbreght (no. 802), probably in Chiapas, Mexico (Gray Herb.).

A perennial herb commonly 30–60 cm. tall, frequently forming a short rhizome, the stems usually branched below, the branches often decumbent at the base, sparingly clothed throughout with rather coarse hairs only along the angles, glabrous for the rest; leaf blades tending to rhomboid, less often ovate, usually cuneate at the base, rarely rounded, not at all cordate, the median 2.5–3.5 cm. long, rarely 4–5 cm., all irregularly serrate or crenate-serrate, their upper surfaces sprinkled with coarser hairs, the lower hirtellous along the veins; flowers opposite in the upper diminished leaves, less often subracemose; calyces sparingly sprinkled with rather coarse ascendent hairs; corolla violet, the galea and tube 15–22 mm. long, the lower stamens seated 9–14 mm. above the base of the tube, mature nutlets not seen.

The collection made by Pringle (no. 4154) near Patzcuaro is similar to the Mociño and Sessé collection. The several species listed above as synonymous seem clearly to fall within the expected variational range of this species, which is now fairly well illustrated in herbaria. Least certain, because of habital differences, are the proposed species from Guatemala and Chiapas, which nevertheless seem to be clearly connected by other Guatemalan collections. The pubescence is characteristic and constant, except perhaps in the specimens from Chiapas and Guatemala.

Distribution (see map 28).—MEXICO. Between San Miguel del Soldado and La Joya *Schiede; ?* Angangino, *Hartweg* 378. VERA CRUZ. Orizaba *Linden* 123; *Galeotti* 681. SAN LUIS POTOSI. Alvarez *Pennell* 17814; *E. Palmer* 133. HIDALGO. Mineral del Monte *Ehrenberg* 119; Real del Monte *Rose* et al. 8704; Pachuca *Rose and Painter* 6506, 6727; Sierra de Pachuca *Pringle* 11102; El Chico *Lyonnet* 191, 192. PUEBLA. Esperanza *Purpus* 5677; Cerro del Comal de Piedra *Purpus* 3968; Ixtaccihuatl *Purpus.* MEXICO AND D. F. Santa Fe *Rose* et al. 8464, 8641; Contreras *Orcutt* 3500; Mexico City to Cuernavaca, kilometer 61 *Mexia* 2717; Meson Viejo, Temascaltepec *Hinton* 1310; Barranca des Chenes, Santa Fe *Bourgeau* 397. MORELOS. El Parque *Orcutt* 4375; Valle del Tepeite *Lyonnet* 1007. MICHOACAN. Patzcuaro *Pringle* 4154; Monte San Miguel, Morelia *Fr. Arsene* 9043; Campanario, Morelia *Fr. Arsene* 8475; Cerro Azul, Morelia *Fr. Arsene* 5510. JALISCO. Bolanos *Rose* 2951. OAXACA. Cuyamecalco *L. C. Smith* 680; Sierra San Felipe *L. C. Smith* 428; *Nelson* 1058; between San Andres and San Miguel *Liebmann* 15736; Chinantla *Liebmann* 15315, 15319, 15558, 15735; Ojo del Agua, Sierra de Oaxaca *Liebmann* 15672, 15733. CHIAPAS. No locality *Ghiesbreght* 87, 802.

GUATEMALA. Chacula, Huehuetenango *Seler* 2824; Chichavac, Chimaltenango *Skutch* 462; San Rafael *Lehmann* 1656.

66. **S. oaxacana** Greenm., Field Mus. Bot. 2: 342, 1912; type collected by Conzatti (no. 1849) in Oaxaca, Mexico (Field Mus.).

S. apiciflora Briq., Ann. Conserv. Gen. 17: 396, 1914; type collected by Purpus (no. 265) in the Sierra Misteca, near San Luis Tultitlanapa, Puebla, Mexico (Deless.).

A perennial herb 15–25 cm. tall, its stems simple or branching near the base, rather closely covered throughout with decurved hairs similar to those of the leaves; leaf blades rotund-ovate, less often deltoid, the median 1.5–2 cm. long, borne on petioles 2–3 mm. long, irregularly and sometimes shallowly crenate-serrate, both surfaces thinly hirsute with rather coarse hairs; flowers in crowded racemes 3–6 cm. long; calyces thinly villous with rather coarse ascendent hairs; galea and tube about 17 mm. long, the lower stamens seated about 10.5 mm. above the base of the tube; apparently mature nutlets brown, tessellated in pattern.

Distribution (see map 28).—MEXICO. PUEBLA. Cerros near San Luis Tultitlanapa *Purpus* 2561. OAXACA. Rancho Nopalera, Nochixtlan *Conzatti* 1849; Las Sedas *Conzatti and Gonzalez* 260; Los Naranjos *Purpus* 2561.

67. **S. blepharophylla** Epl., Lilloa 4: 245, 1939; type collected by Hinton (no. 1050) near Parotas, Guerrero, Mexico (Univ. Calif., L. A.).

A perennial herb 25–35 cm. tall, its stems rather densely clothed with both long and short spreading or decurved hairs; leaf blades broadly ovate, the median 3–3.5 cm. long, somewhat obtuse or acute at the apex, rounded at the base, obscurely sinuate-dentate, the upper surface sprinkled with rather stout jointed hairs, the lower appressed-hirtellous with similar hairs along the veins; petioles 3–4 mm. long; flowers in one-sided racemes 3–8 cm. long, crowded; calyces nearly glabrous, sparingly clothed with ascendent hairs; corolla violet, the galea and tube 19–21 mm. long, the lower stamens seated 12–13 mm. above the base of the tube; nutlets not seen.

Distribution (see map 28).—MEXICO. GUERRERO. Mina, Parotas *Hinton* 10507. MEXICO. Temascaltepec, Rincon del Carmen *Hinton* 1086. MICHOACAN. Coalcoman *Hinton* 13508.

68. **S. russelioides** Epl., Lilloa 4: 246, 1939; type collected by Pennell (no. 20136) on the Mesa del Venteadero near Panuco, Sinaloa, Mexico. (Univ. Calif., L. A.).

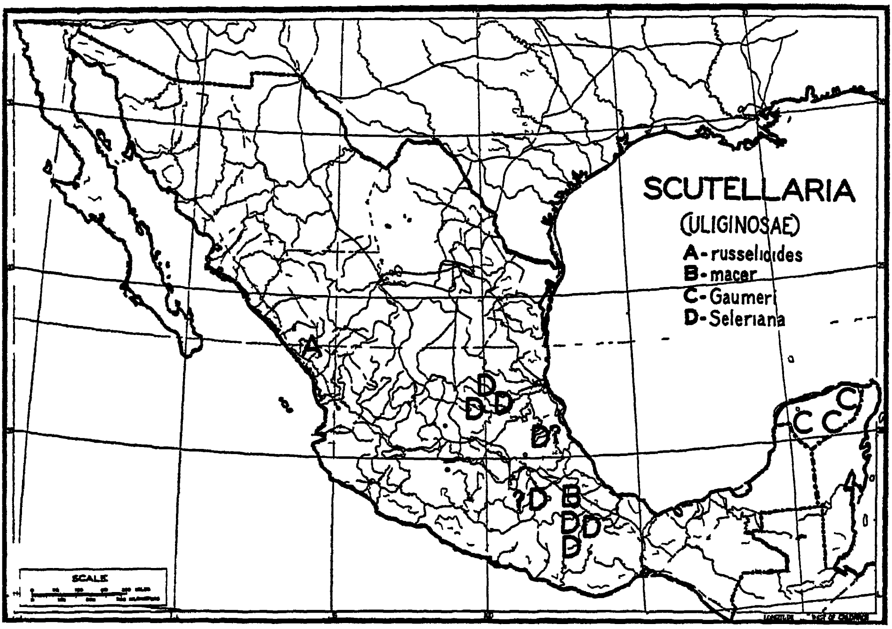
A perennial herb 40–50 cm. tall with rather strict stems, weakly branched in the upper parts and villous throughout with rather stout ascendent and curled hairs; leaf blades prevailingly deltoid, the median 3–3.5 cm. long, rather obtuse, subtruncate at the base, borne on petioles 3–4 mm. long, at least the lower coarsely dentate, the upper gradually diminished and subsessile, all sparingly villous on both surfaces with rather coarse hairs; flowers disposed in the axils of the upper leaves; calyces sparingly villous, 4 mm. long at anthesis; corolla dark violet, the galea and tube 23 mm. long, the lower stamens seated 14 mm. above the base of the tube; nutlets not seen.

Distribution (see map 29).—Known only from the type locality.

69. **S. macer** Epl., Lilloa 4: 247, 1939; type collected by F. Muller in the Sierra de Uluapa, near Orizaba, Vera Cruz, Mexico (N. Y. Bot. Gard.).

S. microphylla Leon., Contr. U. S. Natl. Herb. 22: 723, 1927 (not Moc. et Sessé ex Benth.).

A slender herb, rather impoverished, 30–40 cm. tall, its stems thinly clothed on the angles with ascendent, rather coarse and more or less appressed hairs; leaves variable in size, their blades narrowly rhomboid for the most part, 1–3 cm. long, 6–18 mm. broad, obtuse, cuneate at the base to slender petioles 3–8 or even 12 mm. long, shallowly crenate, nearly glabrous, with only occasional coarse hairs on either surface; flowers axillary, even to the middle of the plant, not at all racemose; calyces sparingly hirtellous but nearly glabrous; galea and tube of corolla about 15 mm. long, the lower stamens seated half this distance above the base of the tube; nutlets not seen.



Map 29. Distribution in Mexico of *S. russelioides, macer, Gaumeri,* and *Seleriana.*

Distribution (see map 29).—MEXICO. VERA CRUZ. Maltrata *Matuda* 1533; Sierra de Uluapa, Orizaba *Muller* 302, 1734, 3029; *Botteri* 111, 176, 577.

70. **S. havanensis** Jacq., Enum. Pl. Carib. 25, 1762, based apparently upon a cultivated specimen.

S. cubensis A. Rich., *in* Sagra, Hist. Cub. Fanerog. 2: 157, 1850, based upon specimens collected in Cuba by Linden (no. 1829); authentic material in herb. of Royal Bot. Gard. (Kew) and in herb. of N. Y. Bot. Gard.

S. longiflora Small, Bull. N. Y. Bot. Gard. 3: 437, 1905; type collected by Small and Carter (no. 1094) between Cutler and Longview Camp, Florida (N. Y. Bot. Gard.).

S. havanensis var. *portoricensis* Leon., Contrib. U. S. Natl. Herb. 22: 737, 1927; type collected by Shafer (no. 3325) in Porto Rico (U. S. Natl. Herb.).

A perennial herb with usually numerous slender stems from a more or less spreading rhizome, decumbent or apparently erect and supported by herbage, 5–50 cm. long, of varied pubescence, the hairs usually small, but either appressed or spreading, either curled upward or downward; leaf blades ovate, prevailingly less than 1 cm. long, rarely 2 cm. long, usually shorter than the elongate internodes, obscurely and irregularly crenate, or entire, rounded at the base or cuneate, both surfaces hispidulous or glabrate, borne on slender petioles rarely 8 mm. or more long; flowers axillary or in rather leafy-bracted racemes; calyces clothed about as the stems, the lower lip 1.5 mm. long at anthesis, 2.5–3 mm. at maturity; corolla violet, the tube and galea 12–17 mm. long, the lower stamens seated 6.5–10.5 mm. above the base of the tube; nutlets black, papillose but apparently variable.

Although this species shows unusual variability in pubescence, there is apparently little correlation with geographic situation. At least three types of pubescence can be discerned. A comparatively coarse type, spreading or downwardly curved, the hairs being about 0.5–.75 mm. long, occurs in Cuba, Haiti, Santo Domingo, Eleuthera, Great Exuma, and Porto Rico. This category contains Leonard's variety, a form with leaves 2–2.5 cm. long; a similar form collected at Valles, San Luis Potosi, Mexico, by Fisher (no. 3333) and at Wartenberg, Huasteca, Vera Cruz by Ervendberg (no. 242) may also be referable here. One of Sintenis specimens (no. 4821), however, has upwardly curled pubescence.

A second type, with hairs smaller and fine, occurs in Cuba, Haiti, and on Cat Island (Bahamas). *S. cubensis* belongs to this category.

The third type, with hair curled upward on stems and leaves but rather variable in size, occurs in Cuba, Great Bahama, Santo Domingo (apparently more common here than the first mentioned type), Porto Rico, and in southern Florida. *S. longiflora* belongs to this category. Although Florida plants are more uniform in habit than those of other regions, being more strict, with somewhat thicker subentire leaves and pubescence of a certain kind, nevertheless plants occur in Cuba which are indistinguishable from those of Florida. Transitional forms occur.

Recently collected in Peten, Guatemala, by Lundell (no. 3614) is a form which, because of the great variability of this complex and the uncertain nature of its occurrence on the mainland, I am reluctant to distinguish by a specific name. It has much of the habit of *S. havanensis,* but suggests also the habit of *S. Gaumeri* of Yucatan. The flowers, too, are similar to the latter, the galea and tube being barely 11 mm. long, with the stamens seated 5 mm. above the base. I have not seen Jacquin's type of *S. havanensis.*

Distribution (see map 27).—Type *A,* with coarser spreading or only slightly decurved hairs:

CUBA. ORIENTE. River cliffs, Ensenada de Mora *Britton* et al. 12958; Sierra de Nipe *Ekman* 9726; Orilla del Guantanamo *Bro. Hioram* 4212; Loma Mensura *Shafer* 3818; no locality *Wright* 461. SANTA CLARA. Rio Caunao *Smith, Hodgdon,* et al. 3055; Cienfuegos *Eugenio Cuesto* 564.

BAHAMAS. Great Exuma *Britton and Millspaugh* 3029; Eleuthera *Coker* 388.

HAITI. Massif du Nord, Ennery *Ekman* 8475; Mole St. Nicolas *Leonard and Leonard* 13193, 13211.

PORTO RICO. Sierra de Naguato, Loma La Mina *Shafer* 3325; Coamo, Rio Tendal *Sintenis* 3102.

SANTO DOMINGO. Constanza *Turkheim* 2928.

Type *B*, the hairs of the stem curling upward, finer but variable (this includes *S. longiflora*):

FLORIDA. Dade: Silver Palm School *Small* 2266; Silver Palm *Small* 7937; between Cutler and Longview Camp *Small and Carter* 1094; between Homestead and Camp Jackson *Small and Carter* 2685; between Long Prairie and Camp Longview *Small and Carter* 2684; Camp Jackson *Small and Carter* 3041; between Homestead and Camp Jackson *Small and Wilson* 1670; Sykes Hammock *Small* et al. 6758; Ross Hammock *Small* et al. 3468; between Camp Jackson and Long Key *Small and Carter* 3183.

CUBA. ORIENTE. Santiago, Cabo Cruz *Ekman* 8462; Sierra de Nipe, Loma Mensura *Ekman* 3170, 9726; Cerro de Fraile near Holquin *Ekman* 3246, 7571; Loma Pilon, near Holquin *Shafer* 1221. HAVANA. Between Loma de Cero and Loma Quinta *Ekman* 7232; Monte La Noria *Wilson* 1913, 9547. PINAR DEL RIO. Bay of Mariel *Britton and Gager* 7568, 7684.

BAHAMAS. Massif de la Selle *Ekman* 7401; between Massif de la Selle and Morne de la Hotte, near Trouin *Ekman* 2380; Massif du Nord, Morne Pedregal *Ekman* 6090.

SANTO DOMINGO. Cordillera Central *Ekman* 16157; Moncion *Valeur* 675, 1030.

PORTO RICO. Tepina near Eneas *Sintenis* 5821.

Type *C*, the hairs fine and curling downward on the stems (this includes *S. cubensis*):

CUBA. ORIENTE. Santiago *Britton* et al. 12696; Holquin *Shafer* 2954; Cabo Cruz *Ekman* 8462. HAVANA. Cojimar *Baker* 2911; Cojimar *Britton* et al. 13976; Guanabo River, Campo Florida *Fr. Leon* 3364, 4734; Cabana Fortress *Fr. Leon* 4672; Cojimar *Killip* 13810.

BAHAMAS. Cat Island *Britton and Millspaugh* 5730.

HAITI. Massif de la Selle *Ekman* 7761; Port de Paix *Leonard and Leonard* 12357.

71. **S. Gaumeri** Leon., Contrib. U. S. Natl. Herb. 22: 742, 1927; type collected by Gaumer (no. 2392) at Pocobock, Yucatan, Mexico (Field Mus.).

A perennial herb 15–25 cm. tall, evidently procumbent or weak, its stems branched in the upper parts, clothed with spreading or somewhat decurved hairs, which are as much as 1 mm. long; leaf blades rhomboid-ovate or ovate, commonly about 2 cm. long, borne on petioles usually less than 10 mm. long, hirsute on both surfaces, less evenly beneath, rather coarsely crenate-serrate; flowers borne in crowded racemes 3–8 cm. long, these sometimes axillary; calyces clothed like the stems, 2.5 mm. long at anthesis, 3.5 mm. long at maturity; corolla violet, the tube and galea 12–15 mm. long, the lower stamens seated 5.5–7.5 mm. above the base of the tube; nutlets black, papillose.

Distribution (see map 29).—YUCATAN. Muna *Steere* 2145; Chichen Itza *Steere* 1453; Pocobock *Gaumer* 2392; Chichankanab *Gaumer* 1435.

72. **S. Seleriana** Loesen., Bull. Herb. Boiss. 7: 568, 1899; type collected by Seler (no. 2799) in Huehuetenango, Guatemala (Berlin).

S. saxicola Brandegee, Univ. Calif. Publ. Bot. 3: 391, 1909; type collected by Purpus (no. 2560) in the Cerro de Paxtle near San Luis Tultitlanapa, Puebla, Mexico (Univ. Calif., Berk.).

A perennial herb often shrubby and twiggy in habit, its stems usually 30–50 cm. tall and apparently intricate, branching freely in the upper parts, hirsute throughout with spreading or somewhat decurved straightish hairs as much as 1 mm. long; leaf blades ovate or rhomboid-ovate, greatly variable in size, 0.5–4 cm. long, borne on petioles rarely as long as 10–12 mm., obtuse or rounded at the apex, more or less cuneate at the base, evenly and closely covered on both surfaces with hairs similar to those on the stems, irregularly and shallowly crenate; flowers disposed in short close racemes 3–5 cm. long, these often axillary; calyces clothed like the stems, 2.5 mm. long at anthesis, 3.5–4 mm. long at maturity; corolla tube and galea 14–20 mm. long, the lower stamens seated 9–11.5 mm. above the base of the tube; mature nutlets not seen.

Distribution (see map 29).—MEXICO. TAMAULIPAS. ?San Lucas *Viereck* 935. NUEVO LEON. Between Las Ajuatas and Potrero Redondo, Mun. de Villa Santiago *Muller* 2698; Huasteca Canyon *Le Sueur* 412 (flowers small). VERA CRUZ. Corral de Pedros, Zacuapan *Purpus* 7809; Barranca de Tenampa, Zacuapan *Purpus* 2010. SAN LUIS POTOSI. Rio de las Gallinas, Rascon *Purpus* 5266, 5867; Guascama near Minas de San Rafael *Purpus* 5256; Tamasopo Canyon *Pringle* 3670, 3910; Tamasopo Canyon *Pennell* 17982. PUEBLA. Rio San Francisco *Purpus* 3967; Cerro de Paxtle, San Luis Tultitlanapa *Purpus* 2560. OAXACA. Jayacatlan *L. C. Smith* 873; Barranca de Tlaculasto and Cosomate *Purpus* 2560; Dominguillo *Nelson* 1851; Cerro de Fentila, Cuicatlan *Conzatti* 3839.

GUATEMALA. Huehuetenango, ?Uaxac-Kanal *Seler* 2799.

SECTION IX. **Spinosae**

Spinosae Epl., Lilloa 4: 254, 1939. The type species is *S. suffrutescens*.

Low suffruticose herbs forming clumps. Stems woody at the base, intricately and divaricately branched above and spinose. Flowers purplish red, borne in the uppermost axils. Corolla tube densely and sharply but broadly pilose-annulate within just beyond the calyx, otherwise glabrous, the lip glabrous. Nutlets black and finely granular. Strongly resembles *S. multicaulis* Boiss. of Syria.

73. **S. suffrutescens** Wats., Proc. Am. Acad. 25: 160, 1890; type collected by Pringle (no. 2535) in the Sierra de la Silla, Nuevo Leon, Mexico (Gray Herb.).

S. spinescens Fern., op. cit., 45: 416, 1910; type collected by Palmer (no. 392) in San Lorenzo Canyon near Saltillo, Coahuila, Mexico (Gray Herb.).

A low twiggy and spinose subshrub, forming small clumps 15–30 cm. tall amongst rocks, the branches cinereous, either with minute conical hairs or with longer, somewhat retrorse hairs; leaves oval, the median commonly 8–12 mm. long, obtuse or rounded at the apex, somewhat narrowed at the base, entire, clothed like the stems; petioles 1–2 mm. long; flowers disposed in the axils of the upper diminished leaves, each branchlet bearing 2–6 flowers; flowering calyces clothed like the stems, scarcely 3 mm. long, the lower lip scarcely 5 mm. long at maturity, the scutellum then subequal; corolla deep rose, the galea and tube 23–26 mm. long, the former 4–6 mm. tall, the lower lip spreading; nutlets black and finely granular.

As pointed out by Leonard, the chief differences in the two proposed species are in the pubescence. These differences are slight, however, and appear to be in degree rather than in kind.

Distribution (see map 30).—MEXICO. COAHUILA. San Lorenzo Canyon, Saltillo *E. Palmer* 392, 394; *Pennell* 17487; mountains south of Saltillo *Pennell* 17320. NUEVO LEON. Summit of Sierra de la Silla *Pringle* 2535; Sierra de la Cebolla, Potrero Redondo to Casillas *Muller* 2136; Cañon Diente near Monterrey *Muller* 2667; La Trinidad, Mun. de Montemorelos *Muller* 2811; Chipinque, near Monterrey *Pennell* 17258.

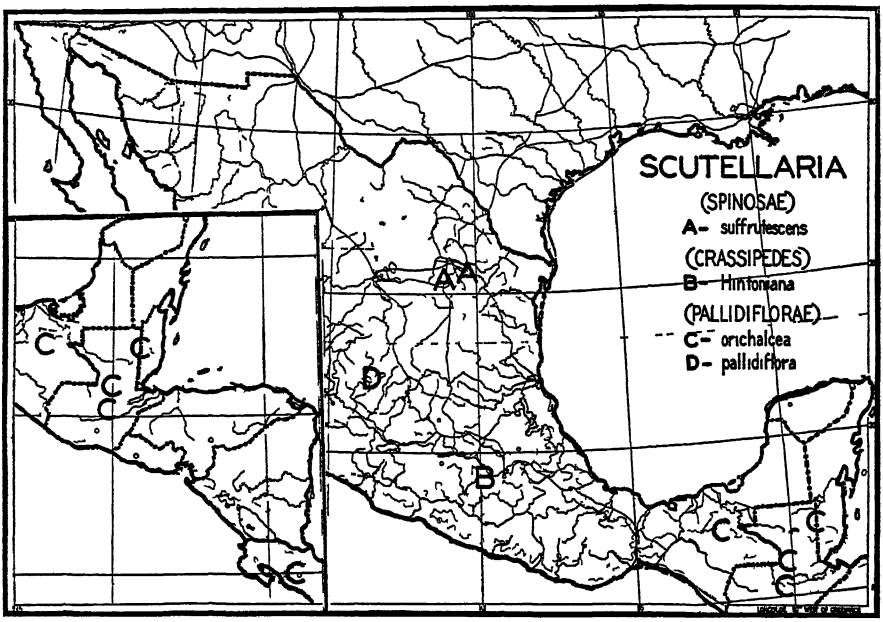
SECTION X. **Crassipedes**

Crassipedes Epl., Lilloa 4: 255, 1939; the type species is *S. Hintoniana*.

Low herbs with thickish rhizomes and thickened fusiform roots, pilose throughout. Flowers in lax racemes, seated in the axils of diminished leaves or leaflike bracts. Corolla purplish red, the lower lip ample, deflexed, the the tube hairy within toward the base. Stamens sometimes shortly exserted. Calyces ample, not seen at maturity. Nutlets unknown.

74. **S. Hintoniana** Epl., Lilloa 4: 255, 1939; type collected by Hinton (no. 1136) in oak woodland near Temascaltepec, Mexico state, Mexico (Univ. Calif., L. A.).

A perennial herb with thickened or fleshy creeping rhizomes, the roots thickened and fusiform; stems densely villous throughout with rather long, spreading, thickish hairs; leaf blades ovate, 2–4 cm. long, 1.5–2.5 cm. broad, obtuse, rounded and narrowed at the base, irregularly and coarsely dentate, but sometimes subentire, both surfaces hirsute with rather long hairs; petioles 3–15 mm. long, flowers few, remote, seated in the axils of the uppermost diminished leaves; flowering calyces 6 mm. long, pilose; corolla scarlet, the galea and tube 33–34 mm. long, the former 10 mm. tall, the tube ample; lower stamens seated 15–16 mm. above the base of the tube; nutlets unknown.



Map 30. Distribution of sections *Spinosae, Crassipedes,* and *Pallidiflorae.*

Although collected by Mociño and Sessé and never named, this species was not again collected until found by Hinton. It is unique and bears no immediate resemblance to any other species.

Distribution (see map 30).—MEXICO. Near Temascaltepec in oak woods *Hinton* 1136, Cumbre Cruz, Temascaltepec *Hinton* 8275; Sierrita, Temascaltepec *Hinton* 4641.

SECTION XI. **Pallidiflorae**

Pallidiflorae Epl., Lilloa 4: 256, 1939; the type species is *S. orichalcea.*

Low herbs with usually several stems arising from a short rootstock which is provided with many fascicled roots. Leaves ovate or elliptical, petiolate. Flowers in short racemes which are frequently axillary, the linear bracts deciduous. Corollas pallid or white, the tube slender and more or less constricted above the calyx, hairy within. Nutlets unknown.

75. **S. orichalcea** J. D. Smith, Bot. Gaz. 14: 29, 1889; type collected by Smith (no. 406).

S. Pedicularis Fern., Proc. Am. Acad. 35: 563, 1900; type collected by Nelson (no. 3342) near Tumbala, Chiapas, Mexico (U. S. Natl. Herb.).

A perennial herb 15–30 cm. tall, with slender stems usually solitary and arising from a short rootstock with fleshy roots, hirtellous throughout with short, upwardly curling or spreading hairs; leaf blades varied, 2–8 cm. long, 1–2.5 cm. broad, now elliptical or ovate and entire, now broadly lanceolate and coarsely sinuate-dentate, the upper surfaces sparingly appressed-hirsute, the lower hispidulous especially along the veins, commonly purple, borne on petioles 1–3 cm. long; flowers in racemes 2–5 cm. long; flowering calyces sparsely hispidulous, 3–4 mm. long, the lower lip 5 mm. long at maturity, the scutellum then 5 mm. tall; corolla white (or the lower lip marked with purple), the galea and tube 19–24 mm. long, the galea about 4.5 mm. long, the tube slender, equal nearly to the lip, the lower stamens seated 10–18 mm. above the base of the tube; nutlets not seen.

In spite of the variation in its leaves, the species is well marked and apparently fairly homogeneous. The variation in corolla is apparently due chiefly to variation in the tube length.

Distribution (see map 30).—MEXICO. CHIAPAS. Tumbala *Nelson* 3342. OAXACA. Distr. Tuxtepec; Chiltepec and vicinity, 20 meters, in llanos, *Martinez Calderon* 503; 229.

BRITISH HONDURAS. Upper Maho River *Peck* 572; Valentin, El Cayo District *Lundell* 6130, 6218.

GUATEMALA. Secanquim, Alta Vera Paz *Pittier* 187, 244; Cerro Putul, Quiche *Skutch* 1828; Chajrax, Alta Vera Paz *J. D. Smith* 406; Alta Vera Paz *Turckheim* 8264.

COSTA RICA. Laguna de la Escuadra, near El Copey, San Jose *Standley* 41989.

76. **S. pallidiflora** Epl., Lilloa 4: 257, 1939; type collected by Rose (no. 2487) near Huejuquilla, Jalisco, Mexico (Gray Herb.).

An herb, presumably perennial, the branches puberulent with minute spreading hairs, the inflorescence viscid with rather long glandular hairs, the lower parts not preserved; leaf blades ovate, 5–5.5 cm. long, 3–3.5 cm. broad, obtuse, rounded at the base, subentire, both surfaces glabrous unless minutely hirtellous on the veins below; petioles 1.5–2.5 cm. long; flowers opposite, disposed in naked racemes 5–8 cm. long; flowering calyces 2 mm. long, capitate-glandular, the lower lip 4.5 mm. long at maturity; corolla white or whitish, the galea and tube 16 mm. long; lower stamens seated 7 mm. above the base of the tube; nutlets not seen.

Distribution (see map 30).—Known only from the type specimen.

SECTION XII. Speciosae

Speciosae Epl., Lilloa 4: 258, 1939. Subsect. *Speciosae* Epl., Rept. Spec. Nov. 85: 174, 1936. The type species is *S. Ventenatii.*

Sufficiently large herbs with one or more stems which apparently arise from a short caudex, clothed in the upper parts with usually spreading, less often curled, hairs. Leaves ample, ovate, frequently cordate, infrequently elliptical, softly and more or less equally pubescent on both surfaces. Flowers in elongated showy racemes, subopposite or falsely verticillate. Corollas red, rarely reddish-purple, or marked with blue, gently arcuate, the tube hairy within but not annulate. Nutlets scarcely known, probably black.

KEY TO THE SPECIES

A. Colombian or Venezuelan plants.
  B. Petioles 2–6 cm. long; corolla rose and blue, its tube 20–25 mm. long 82. **S. roseocyanea**
  BB. Petioles rarely 2 cm. long, usually 1–1.6 cm.; corolla evenly red, except *S. cyanocheila.*
    C. Corolla tube 10–12 mm. long; plants of Tolima............. 78. **S. Lehmanni**
    CC. Corolla tube 15–20 mm. long.

D. Leaves elliptical, or narrowly ovate, narowed toward the base, mostly 1–2.5 cm. broad.
 E. Corolla evenly red, its tube 17–20 mm. long........80. **S. incarnata**
 EE. Corolla tube 15–16 mm. long, rose, the lower lip blue; plants of Antioquia...................................81. **S. cyanocheila**
  F. Leaves ovate, rounded at the base or subcordate, mostly 2–6 cm. broad.
   G. Leaves rounded at the base, hardly cordate, the upper surfaces nearly glabrous, petioles 8–20 mm. long
   79. **S. Trianae**
   GG. Leaves more or less cordate, the upper surfaces softly pubescent; petioles 1–3.5 cm. long.........77. **S. Ventenatii**

AA. North American or West Indian plants, chiefly Mexican.
 B. Petioles 2–3 mm. long; plants of Sinaloa.........................86. **S. Rosei**
 BB. Petioles 1–5 cm. long.
  C. Lower stamens seated 10 mm. above the base of the tube; plants of Guerrero and Mexico...84. **S. multiflora**
  CC. Lower stamens seated 14–18 mm. above the base of the tube.
   D. Leaves clearly and constantly cordate at the base; galea 3 mm. tall; plants of Vera Cruz..................................83. **S. splendens**
   DD. Leaves mostly rounded at the base, sometimes lightly cordate; galea 6 mm. tall.
    E. Upper surfaces of leaves glabrate; calyces minutely hispidulous; corolla golden; plants of Oaxaca....................85. **S. aurea**
    EE. Upper surfaces of leaves softly pubescent and glandular; corollas scarlet; naturalized in North America, chiefly in the West Indies
    77. **S. Ventenatii**

77. **S. Ventenatii** Hook., Bot. Mag. 72, pl. 4271, 1846; type a garden specimen grown from seeds collected by Purdie in the Santa Marta Mountains, Colombia (Kew).

S. scarlatina Planch. et Lind. ex Lemaire, L'Illus. Hort. 3, pl. 104, 1856; type a garden specimen grown from seeds collected by Triana near Bogota, Colombia.

?*S. ornata* Leon., Contrib. U. S. Natl. Herb. 22: 717, 1927; type a cultivated plant collected by Standley (no. 23664) at Puerta de la Laguna, Libertad, El Salvador (U. S. Natl. Herb.).

A showy and lovely perennial herb as much as a meter tall, branching in the upper parts, ashy with short spreading hairs that are sometimes purple; leaf blades broadly ovate, the median 4–8 cm. long, 3.5–6 cm. broad, rather obtuse at the apex or shortly acuminate, usually cordate at the base, the margins rather convex, subentire, the upper surface softly pubescent with short close hairs, sprinkled with sessile pellucid glands, the lower paler, softly hirsute with somewhat longer hairs; petioles 1–3.5 cm. long; racemes at length 10–25 cm. long, clothed with short spreading hairs and somewhat glandular; flowers rather crowded, subopposite in the axils of deciduous bracts 2–3 mm. long; flowering calyces 2.5–3 mm. long, glandular-pubescent, the lower lip 5–6 mm. long at maturity, the scutellum then about 5 mm. tall; corolla scarlet, the tube 18–20 mm. long; nutlets black, regularly tuberculate.

Distribution (see map 32).—Venezuela. Prov. Trujillo *Funck and Schlim* 772.

Colombia. Cundinamarca. Santa Fe de Bogota *Goudot; Dawe* 46; *Triana; Tracy* 52; Susumuco near Quetame *Pennell* 1724; Fusagasuga *Holton* 489; Fusagasuga to Pandi *Pennell* 2752; Pandi *Pennell* 2823; El Cauca. Tulua *Holton;* Rio Dabio *Lehmann* 3293.

Apparently native to Venezuela and Colombia this species has become widely naturalized in the West Indies or is collected as an escape. It has been collected in Trinidad *Broadway* 6623; in Martinique *Mouret* 339; *Duss* 1973; in Dominica *Cooper* III 148; *Lloyd* 256, 472; in Guadeloupe *Duss* 2150; in San Domingo *Eggers* 697; abundantly in Jamaica

Harris 6278, 6318, 8824, 12387, 12645; *Maxon* 2265, 8521, 8829; *Orcutt* 2597, 2806; *Maxon and Killip* 485; *Lloyd* 1125; *Britton* 321, 1469, 3222; in EL SALVADOR *Standley* 23664; and in BRAZIL Rio Janeiro, Catumby *Mosen* 2546; Rio Janeiro, Tijuca *Hieronymus and Niederlein*.

What may be a hybrid between *S. Ventenatii* and a purple-flowered species, possibly *S. purpurascens*, has been collected in GUADELOUPE *Duss* 3474, N. Y. Bot. Gard.

78. **S. Lehmanni** Regel, Gartenflora 33: 129, pl. 1152, 1884; type a cultivated specimen.

A perennial herb 40–60 cm. tall with prevailingly simple stems which are ashy in the upper parts with spreading more or less glandular hairs, the median internodes 5–10 cm. long; leaf blades broadly ovate, 4.5–8 cm. long, 3.5–6 cm. broad, acute at the apex and shortly acuminate, rounded or even subcordate at the base, their margins strongly convex below the middle, sparingly sinuate-dentate with small acute teeth, the upper surface dark green, very shortly hirtellous, the lower softly pubescent, ashy; petioles 8–20 mm. long; racemes 3–8 cm. long, glandular with spreading hairs, the flowers rather crowded, irregularly disposed in the axils of deciduous lanceolate bracts; flowering calyces 2.5–3 mm. long, glandular-pubescent, the lower lip 4 mm. long at maturity, the scutellum then about 4–4.5 mm. tall; corolla scarlet, its tube slender, gradually enlarged upward, 10–12 mm. long; nutlets unknown.

Distribution (see map 32).—COLOMBIA. TOLIMA. Dolores *Lehmann* 7866; *Lehmann* 2338; Carnicerias to Iquira *Lehmann* 6044; Alto del Gaucho near Ate *Woronow* 7006.

79. **S. Trianae** Planch. and Lind., Belg. Hort. 6: 232, 1856; type a cultivated specimen grown from seeds collected by Triana near Bogota, Colombia.

S. amarantina Planch. and Lind. ex Galeotti, Jour. Hort. Prat. ser. 2, 2: 217, 1858; type a cultivated specimen grown from seeds collected by Triana near Bogota, Colombia; a color form of *S. Trianae*.

An ascendent herb, sometimes apparently sprawling or climbing, 50–60 cm. tall and more, the stems cinereous in the upper parts with spreading hairs; median leaf blades 3–6 cm. long, 1.5–3.5 cm. broad, ovate, shortly acuminate, rounded at the base and not at all cordate, their margins sufficiently convex, dentate-serrate, the upper surface dark green, nearly glabrous, sprinkled with minute hairs, the lower ashy pubescent; petioles slender, 8–20 mm. long; racemes at length 15–20 cm. long, glandular with short spreading hairs; flowers irregularly disposed in the axils of usually persistent linear-lanceolate bracts; pedicels 3–5 mm. long; flowering calyces 2.5–3 mm. long, glandular puberulent, the lower lip 5 mm. long at maturity, the scutellum then about as tall; corolla reddish-purple, the tube gradually enlarged upward, 18–22 mm. long; nutlets not seen.

Distribution (see map 32).—COLOMBIA. CUNDINAMARCA. Mesa Grande near Bogota *Lehmann* 8813; Quetame to Susumuco *Pennell* 1350; Quetame *André* 983. TOLIMA. Mariquita, near Piedras *Triana* 2031. EL CAUCA. Patia, Popayan *André* 2927; mountains of Popayan *Lehmann* 6143, 7865; Almaguer *Triana;* Rio Ortega near Tambo *Pennell and Killip* 8048; San Antonio *Pennell and Killip* 7282; Cañitas *André* 2740; Rio Palace *André* 2740.

80. **S. incarnata** Vent., Choix Pl. 39, 1803; type collected by Umana near Bogota, Colombia (Deless.).

A perennial herb 30–50 cm. tall, more or less branched in the upper parts and ashy pubescent; leaf blades 2.5–5 cm. long, narrowly ovate or sometimes elliptical, acute at the apex, rounded and narrowed at the base, sometimes subcuneate, their margins rather convex, lightly dentate-serrate or subentire, the upper surface dark green, hirtellous, the lower ashy pubescent, sometimes purplish; petioles 8–20 mm. long; racemes at length 10–20 cm. long, glandular-pubescent; flowers irregularly disposed in the axils of deciduous, lanceolate bracts; pedicels 2–4 mm. long; flowering calyces 3 mm. long, glandular-hirtellous, the lower lip 5 mm. long at maturity, the scutellum then 4–4.5 mm. tall; corolla scarlet, the tube slender, gradually enlarged upward, 17–20 mm. long; nutlets black, tuberculate.

Distribution (see map 32).—VENEZUELA. TRUJILLO. Pavo *Funck and Schlim* 772; Miraflores near Palmira *Pittier* 906.

COLOMBIA. VALLE DEL CAUCA. Buga *Triana* 2032. CUNDINAMARCA. Bogota *Umana;* Tena *Triana* 2028; Cachipay *Tracy;* Barroblanco near Fusagasuga *Andre.* TOLIMA. El Convenio, San Lorenzo *Pennell* 3500. HUILA. Neiva *Rusby and Pennell* 422, 587. EL CAUCA. Rio Piendamo near Popayan *Pennell and Killip* 8285; Rio Pala *Pittier* 1040; Patia *Lehmann;* Popayan *Lehmann* 7865. NARINO. Tablon to Pasto *Lehmann* 6174. CALDAS. San Francisco *Pennell* 10181.

81. **S. cyanocheila** Epl., Rept. Spec. Nov. 85: 176, 1936; type collected by Lehmann (no. 7868) near Pinguru and Toyo above Antioquia, Colombia (Kew).

A perennial herb as much as 60 cm. tall with branching stems, the branches clothed with short spreading hairs, the internodes 3–12 cm. long; leaf blades soft, elliptical, 2–5 cm. long, 1–2 cm. broad, acute at the apex, narrowed at the base, subentire or lightly serrate, both surfaces shortly pubescent; petioles 3–12 mm. long; flowers congested into short spikes 2–5 cm. long, the verticils at length 3–5 mm. distant, subtended by small deciduous bracts; flowering calyces 3 mm. long, sparingly clothed with short spreading hairs, the lower lip 5 mm. long at maturity; pedicels spreading-pubescent, 4–6 mm. long; corolla tube rose, 15–16 mm. long, the lower lip blue; nutlets not seen.

Distribution (see map 32).—COLOMBIA. ANTIOQUIA. Pinguru and Toyo near Antioquia *Lehmann* 7868; Buritica *Kahlbreyer* 1748.

82. **S. roseo-cyanea** Epl., Rept. Spec. Nov. 85: 176, 1936; type collected by Kahlbreyer (no. 1746) near Buritica, Antioquia, Colombia (Kew).

A perennial herb a meter tall or more, softly clothed in the upper parts with spreading glandular hairs; leaf blades soft, 4–12 cm. long, 3–10 cm. broad, cordate (possibly sometimes rounded at the base), shortly acuminate, sinuate-dentate, the upper surface sparingly hirsute, the lower paler, softly pubescent; petioles 2–6 cm. long; racemes at length 30 cm. long, the flowers subopposite or subverticillate in the axils of deciduous ovate bracts 3–4 mm. broad; pedicels 3–4 mm. long; flowering calyces 4 mm. long, hirsute, the lower lip 6 mm. long at maturity, the scutellum then subequal; corolla tube rose, gradually enlarged upward, 20–25 mm. long, the lower lip dark blue; nutlets papillate.

Distribution (see map 32).—COLOMBIA. ANTIOQUIA. Buritica *Kahlbreyer* 1746; ?Dabeiba *Lehmann* 4734; ?Santa Rosa, between Hoyo-rico and Saraneta *Lehmann* 7265.

83. **S. splendens** Link ex Klotzsch et Otto, Icon. Pl. Rar. 1: 31, pl. 13, 1841; type a specimen cultivated in the botanic garden at Berlin (Berlin).

Perilomia cordifolia Cham. et Schlect., Linnaea 6: 374, 1831; type collected by Schiede and Deppe at Misantla, Mexico (no. 1176); not *S. cordifolia* Muhl., 1813 (Berlin).

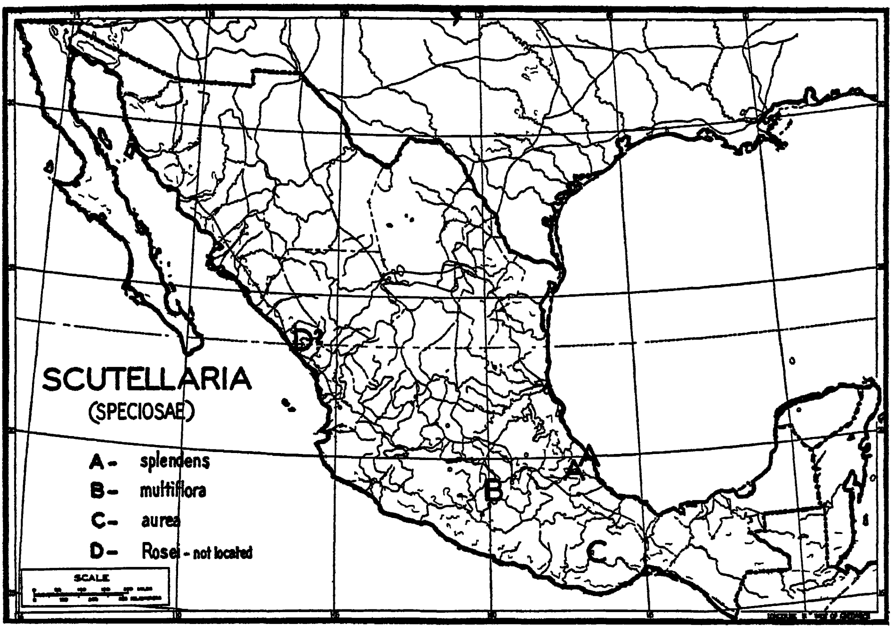
A perennial herb apparently less than a meter tall, its stems densely pilose with shorter and longer hairs, some glandular; leaf blades thin, cordate, 4–11 cm. long, their margins irregularly crenulate-serrate or sinuate, both surfaces pilose with longer hairs, the lower pale; petioles 2–5 cm. long; flowers in racemes 15–30 cm. long, the lowermost often remote; flowering calyces spreading glandular, the lower lip 3–3.5 mm. long at anthesis, 6 mm. long at maturity, the scutellum then 4 mm. tall; galea and tube 21–25 mm. long, the galea about 3 mm. long, the lower stamens seated 14–17 mm. above the base of the tube; nutlets not seen.

Distribution (see map 31).—MEXICO. VERA CRUZ. Misantla *Purpus* 5910; *Schiede and Deppe* 1176; Zacuapan *Purpus* 1930, 12057, 12058; *Linden* 209; Veracruz *Galeotti* 907; Colipa *Liebmann* 15257; Mirador *Liebmann* 15646; Totutla *Liebmann* 15643.

84. **S. multiflora** Benth., *in* Lindl. Bot. Reg. 18, pl. 1493, 1832; based upon a specimen collected in Mexico by Mociño and Sessé; probable type, formerly in Lambert Herb., in herb. of the Univ. Oxf.; authentic material in Madrid Herb.

A perennial herb nearly a meter tall, its stems clothed in the upper parts with both short and long spreading hairs; leaf blades broadly ovate, 6–7 cm. long, 5–6 cm. broad, irregularly sinuate-dentate, shortly acuminate at the apex, rounded at the base or even subcordate, the upper surface nearly glabrous, hirtellous chiefly along the veins, the lower paler, usually clothed along the veins with variable hairs; petioles 2–4 cm. long; flowers in panicled racemes 10–20 cm. long; calyces appressed-hirtellous, the lower lip 3.5 mm. long at anthesis, 6 mm. long at maturity, the scutellum then about 4 mm. tall; corolla cardinal red, the galea and tube 19–20 mm. long, the former 4 mm. tall; lower stamens seated 10 mm. above the base of the tube; nutlets not seen.

Distribution (see map 31).—MEXICO. GUERRERO. Adama, Achotla, trail to Suriana *Mexia* 8821. MEXICO. Temascaltepec, Ypericones *Hinton* 8428; Temascaltepec, Nanchititla *Hinton* 5319.



Map 31. Distribution in Mexico of the section *Speciosae.*

85. **S. aurea** Robinson and Greenm., Am. Jour. Sci. 50: 163, 1895; type collected by L. C. Smith (no. 173) at the Rancho Calderon, Oaxaca, Mexico (Gray Herb.).

S. aurea var. *Conzattii* Greenm., Field Mus. Bot. 2: 261, 1895; type collected by Conzatti (no. 1584) in Cerro Antonio, Oaxaca, Mexico. (Field Mus.).

A perennial herb, its stems densely covered with shorter and longer hairs which are mostly retrorse, becoming shorter and spreading in the inflorescence; leaf blades broadly ovate or ovate-lanceolate, mostly 7–9 cm. long, 3–7 cm. broad, lightly cordate or rounded at the base, rather coarsely toothed, the upper surfaces essentially glabrous, hirtellous along the veins, the lower paler and hispidulous with straight hairs; petioles 1–3 cm. long; flowers in racemes 8–10 cm. long, these seemingly somewhat paniculate; calyces minutely hispidulous with spreading conical hairs, the lower lip 4 mm. tall; corolla said to be orange, its galea and tube 25 mm. long, the former about 6 mm. long, the lower lip flaring, the lower stamens seated about 14 mm. above the base of the tube; nutlets not seen.

Distribution (see map 31).—MEXICO. OAXACA. Rancho de Calderon, Oaxaca *L. C. Smith* 173; Cerro San Antonio *Conzatti* 1584.

86. **S. Rosei** Fern., Proc. Am. Acad. 35: 563, 1900; type collected by Rose (no. 1784) near Colomas, Sinaloa, Mexico (U. S. Natl. Herb.).

A perennial herb 60–70 cm. tall, apparently with several ascendent simple stems, these closely covered with spreading sharp hairs, but capitate-glandular in the inflorescence; leaf blades broadly ovate, mostly 5–6 cm. long, about 4 cm. broad, shortly acuminate, subcordate at the base, their margins rather coarsely sinuate-dentate, the upper surfaces thinly hirsute with longer and shorter appressed hairs, the lower paler, thinly covered with shorter straight and spreading hairs; petioles 2–3 mm. long; flowers irregularly scattered in racemes 15–25 cm. long; flowering calyces spreading hispidulous and capitate-glandular, the lower lip 4 mm. long at anthesis; corolla seemingly purple-red, its galea and tube 25 mm. long, the galea 7 mm. long, the lower lip ample, twice as long as the upper, the lower stamens seated 14 mm. above the base of the tube; nutlets not seen.

Distribution (see map 31).—Known only from the type specimen.

SECTION XIII. **Cardinales**

Cardinales Epl., Lilloa 4: 263, 1939; the type species is *S. longifolia* Benth.

Large herbs, straggling and apparently supporting themselves in part upon other herbage, with one or more slender stems which arise from a short caudex, puberulent with curled hairs, infrequently with spreading ones, or glabrate. Leaves narrowly ovate and rounded at the base, ample, long-acuminate, or smaller and elliptical, glabrous or sparingly hirsute above, usually hirtellous on the veins beneath. Flowers in racemes, sometimes short, sometimes elongate and showy. Corolla bright red, large and showy, the tube gradually arcuate, or abruptly bent at right angles, hairy within. Nutlets scarcely known, black or seemingly gray or fuscous, roughened. The position of the stamens of the South American species needs to be reëxamined.

KEY TO THE SPECIES

A. Petioles 1 cm. long or less; leaves mostly 1.5–2 cm. broad; plants of Venezuela and Colombia.
  B. Corolla tube 25 mm. long; hairs of branchlets spreading; plants of Merida 87. **S. Lindeniana**
  BB. Corolla tube 35 mm. long; hairs of branchlets curled; plants of Tolima 88. **S. leptosiphon**
AA. Petioles 1–4 cm. long or more; leaves mostly 2–7 cm. broad; plants of Mexico and Central America.
  BB. Branches of the inflorescence hirtellous with minute or small curled and more or less appressed hairs or glabrous.
    C. Galea and tube of corolla 53–62 mm. long................94. **S. costaricana**
    CC. Galea and tube of corolla 20–45 mm. long.
      D. Corolla bent at right angles about one-third its length from the base, the galea and tube 40–45 mm. long; hairs of stem curled upward (see also 96. *S. formosa*)..............................95. **S. Mociniana**
      DD. Corolla arcuate or lightly sigmoid, even straight, but not bent at right angles, 20–31 mm. long.
        E. Corolla tube and galea 20–24 mm. long, the lower stamens seated 13–14 mm. above the base of the tube................91. **S. glabra**
        EE. Corolla tube and galea 26–31 mm. long, the lower stamens seated 17–18 mm. above the base of the tube.
          F. Pubescence of inflorescence minute and appressed; petioles 2–4 cm. long; leaves mostly ovate, 8–10 cm. long; corolla lightly sigmoid..................................89. **S. longiflora**
          FF. Pubescence of inflorescence small and curled upward but scarcely appressed; petioles 1–2 cm. long; leaves mostly elliptical, 5–8 cm. long; corollas arcuate.............90. **S. isocheila**

BB. Branches of the inflorescence covered with spreading hairs usually rather long, less often short and conical, the branches below bearing similar or longer hairs (except 96. *S. formosa*).

C. Branches below the inflorescence thinly pubescent with downwardly curled hairs, soon becoming glabrous; corolla bent at right angles about one-third its length from the base, the galea and tube 40–45 mm. long, gradually enlarged upward, the lower lip 5–6 mm. long....................................96. **S. formosa**

CC. Branches below the inflorescence well covered with spreading hairs.

D. Corolla tube and galea 40–42 mm. long.

E. Corolla tube arcuate, but hardly bent at right angles, inflated above the bend, narrowed toward the limb which is 5–6 mm. long; petioles 1.5–2.5 cm. long..97. **S. inflata**

EE. Corolla tube straight or lightly arcuate, the lower lip 6–7 mm. long; leaves hirsute on both surfaces, the petioles 3–8 mm. long 93. **S. Lundellii**

DD. Corolla tube and galea 26–30 mm. long.....................92. **S. Maxonii**

87. **S. Lindeniana** Benth., DC. Prodr. 12: 421, 1848; type collected by Linden (no. 467) in the "Andes of Trujillo and Merida," Venezuela (Kew).

A diffuse suffruticose herb probably sprawling over other vegetation or supported by it, its stems slender, puberulent in the upper parts with spreading hairs; leaf blades 3.5 cm. long, 1.5–2 cm. broad, elliptical, subequally narrowed both ways from the middle, acute at the apex, but rather obtuse at the base, subentire, the upper surface glabrous, the lower minutely puberulent along the veins; petioles 5–10 mm. long; racemes 5–10 cm. long, the flowers subopposite, subtended by tardily deciduous ovate-lanceolate bracts; pedicels 3–5 mm. long; flowering calyces 4–4.5 mm. long, glandular-hirtellous, the lower lip 6–7 mm. long at maturity, the scutellum then subequal; corolla probably scarlet, the tube gradually enlarged upward, somewhat arcuate, about 25 mm. long, the orifice about 5 mm. in diameter; nutlets not seen.

Distribution (see map 32).—VENEZUELA. MERIDA. Mountains near Merida *Linden* 467; *Moritz* 988.

88. **S. leptosiphon** nom. nov.

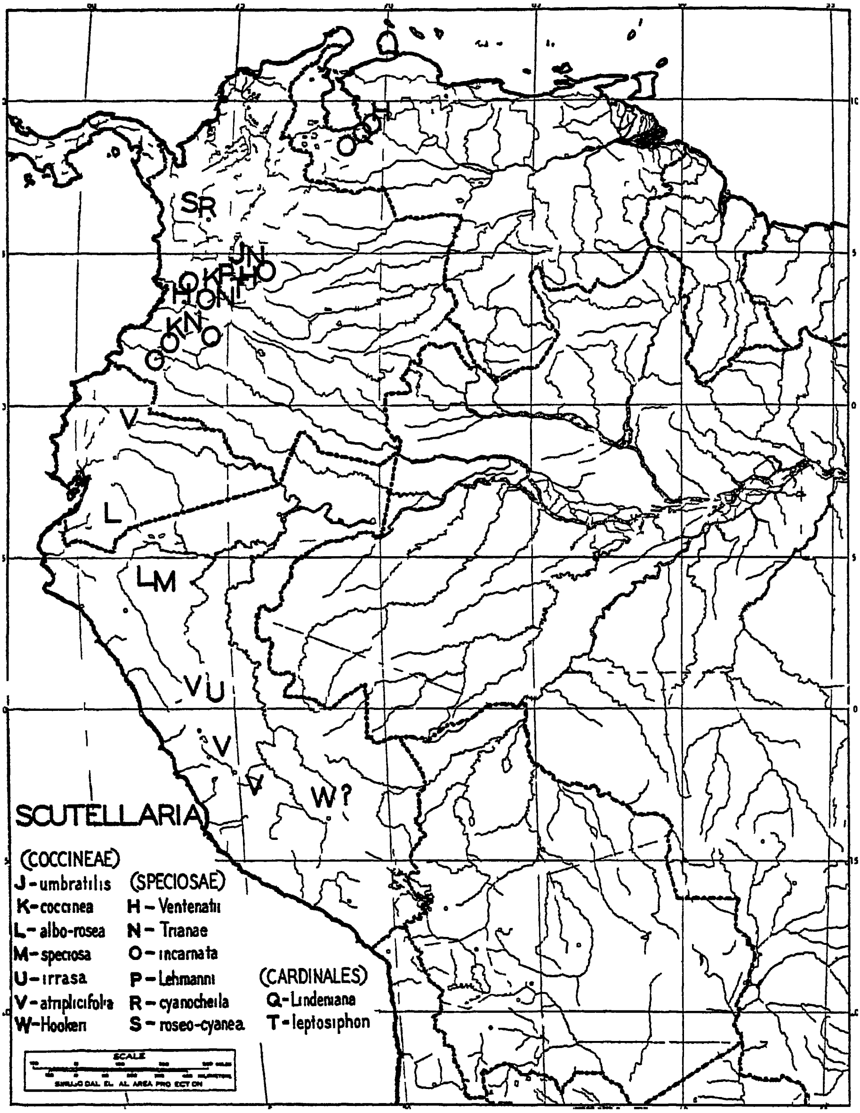
S. elliptica Epl., Rept. Spec. Nov. 85: 177, 1936 (nec Muhl. nec Spreng.); type collected by Lehmann (no. 2348) near Santa Ana, Tolima, Colombia (U. S. Natl. Herb.).

Apparently a suffruticose herb with simple elongate ascendent stems which are pubescent with curled hairs in the upper parts, the internodes 3–8 cm. long; leaf blades rather leathery, elliptical, 5–7 cm. long, 1.5–2 cm. broad, rather acute at the apex but evenly narrowed both ways from the middle, subentire, the upper surface glabrous, the lower hirtellous with minute hairs along the veins; petioles 4–6 mm. long; racemes elongate, pubescent with curled hairs, the flowers crowded, irregularly disposed in the axils of linear-oblong persistent bracts; flowering calyces 4.5–5 mm. long, shortly hirtellous, not seen at maturity; pedicels 2–3 mm. long; corolla scarlet, the tube attenuate toward the base, gradually enlarged upward, 35 mm. long; nutlets not seen.

Distribution (see map 32).—Known only from the type specimen.

89. **S. longifolia** Benth., *in* Lindl. Bot. Reg. 18; pl. 1493, 1832; based upon a specimen collected by Mociño and Sessé in Mexico; probable type, formerly in Lambert herb., in herb. of Univ. Oxf.; authentic material in Madrid Herb.

A perennial herb 40–50 cm. tall or more, its branches minutely hirtellous with appressed hairs; leaf blades mostly 8–10 cm. long, ovate or ovate-lanceolate, widest toward the base, which is usually rounded, gradually acuminate upward, borne on petioles mostly 2–4 cm. long, their margins sinuate-serrate, the upper surfaces glabrous, the lower minutely hirtellous along the veins; flowers in racemes 10–30 cm. long, often branched; calyces minutely hirtellous, the lower lip 3.5–4 mm. long at anthesis, somewhat longer at maturity, the



Map 32. Distribution in South America of the sections *Cardinales*, *Speciosae*, and *Coccineae*.

scutellum then 6 mm. tall; galea and tube 26–30 mm. long, the galea about 4 mm. tall, the lower stamens seated about 17–18 mm. above the base of the tube; nutlets black, papillose.

The flowers give the appearance of having been scarlet; the corolla tube is slightly sigmoid rather than arcuate. A specimen collected at El Parvenir, Guerrero, by Langlassé has smaller leaves, notably cuneate at the base.

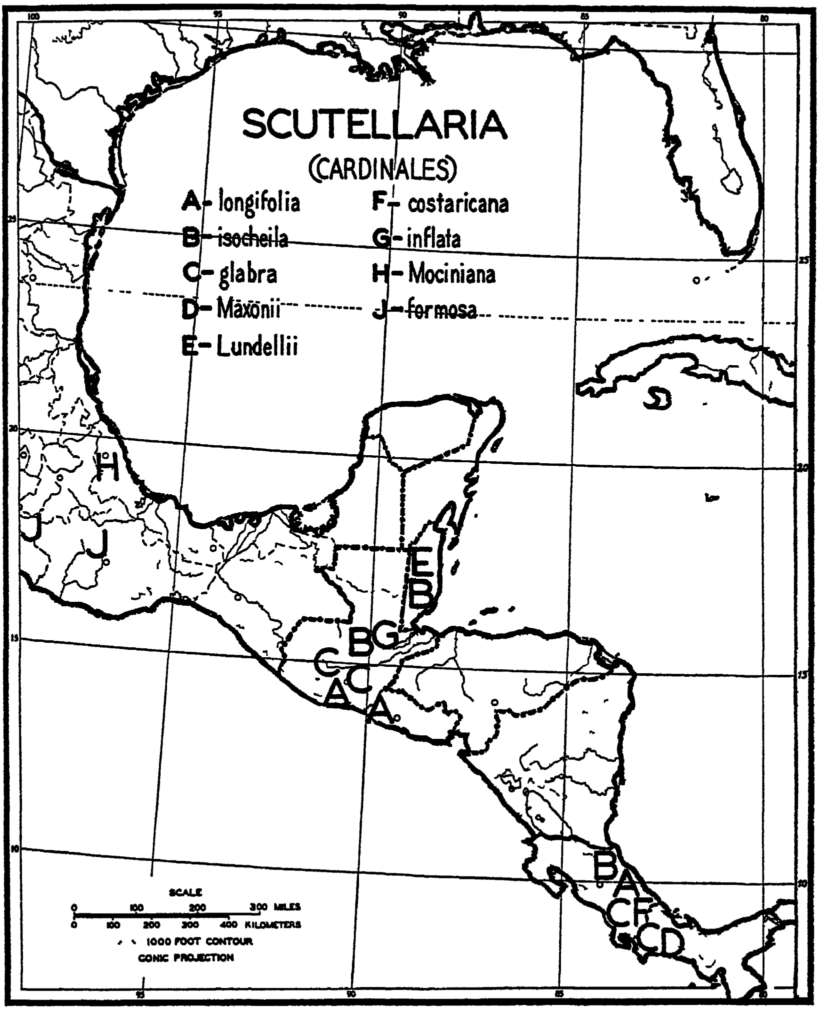
Distribution (see map 33).—MEXICO. GUERRERO. ? El Parvenir *Langlassé* 965.

GUATEMALA. Acotepeque, Zacatepequez *Smith* 2596; Volcan Tecuamburio, Santa Rosa *Heyde and Lux* 4566; San Vicente Tecaya, Amatitlan *Tonduz* 479.

COSTA RICA. Atirro, Cartago *Smith* 6700; Rio Convento and Buenos Aires *Tonduz* 4021.

El Salvador. Ahuachapan. Ceresita *Padilla* 167; Chula *Padilla* 166; without locality *Padilla* 24.

90. **S. isocheila** J. D. Smith, Bot. Gaz. 57: 426, 1914; type collected by Pittier (no. 16128) in wet forests of the Cerro de Carizia, Heredia, Costa Rica (U. S. Natl. Herb.).



Map 33. Distribution in Mexico and Central America of the section *Cardinales*.

A perennial herb as much as a meter tall, its branches pubescent with upwardly curled hairs; leaf blades mostly 5–8 cm. long, 2–3.5 cm. broad, prevailingly elliptical or oblong-elliptical, acuminate, usually cuneate at the base, borne on petioles 1–2 cm. long, their margins subentire or shallowly sinuate-serrate, the upper surface glabrous or essentially so, the lower notably paler and minutely hirtellous along the veins; flowers in racemes 2–5 cm., rarely 10 cm. long; calyces minutely hirtellous, the lower lip 3.5–4 mm. long at anthesis, about 6 mm. at maturity, the scutellum then 7–8 mm. tall; galea and tube 30–31 mm., the galea about 4 mm. tall, the lower stamens seated about 17–18 mm. above the base of the tube; nutlets tan, smoothish or sparingly roughened.

The flowers are said by Standley to be bright rose-red with a white lip; the tube is clearly arcuate.

Distribution (see map 33).—GUATEMALA. Chama to Coban, Alta Vera Paz *H. Johnson* 199.

COSTA RICA. Alto de la Estrella, Cartago *Standley* 39119, 39134; Cerro de Carizia, Heredia *Pittier* 16128; Viento Fresco, Alajuela *Standley and Torres* 47823, 47847; Yerba Buena, near San Isidro, Heredia *Standley and Valerio* 49105, 49712, 49764; Cerros de Zurqui near San Isidro, Heredia *Standley and Valerio* 50547; Cerro de las Caricias, near San Isidro, Heredia *Standley and Valerio* 52188.

91. **S. glabra** Leon., Contrib. U. S. Natl. Herb. 22: 715, 1927; type collected by Pittier (no. 11194) at Platanillo, on the Canas Gordas Road, Costa Rica (U. S. Natl. Herb.).

A perennial herb or half shrub often subscandent, a meter tall or more, its branches quite glabrous unless microscopically puberulent in the inflorescence; leaf blades prevailingly ovate, sometimes narrowly so, 6–15 cm. long, 3–7 cm. broad, long-acuminate, mostly rounded at the base, usually very narrowly and shallowly cordate, both surfaces glabrous, the margins shallowly sinuate or subentire; petioles 1.5–5 cm. long; flowers in racemes 10–25 cm. long, the reflexed bracts rather conspicuous in flower or early deciduous; flowering calyces glabrous, the lower lip 2.5–3.5 mm. long, about 5 mm. at maturity, the squama then about 5 mm. tall; galea and tube 20–27 mm. long, the galea about 4.5 mm. long, the tube subinvaginate and constricted just beyond the calyx, nearly straight, the lower stamens seated 13–15 mm. above its base; nutlets black, evenly papillose.

The Guatemalan specimens have leaves mostly 5–8 cm. long.

Distribution (see map 33).—GUATEMALA. CHIMALTENANGO. Panajabel, 1350 m. *Standley* 62120, 62128. SACATEPEQUEZ. Barranca Hondo, Volcan de Fuego 1800 m. *Standley* 60279; near Barranca Hondo, southeast of Alotenango, 1000–1260 m. *Standley* 65032. ESCUINTLA. Near Las Laja, 1200 m. *Standley* 58149.

COSTA RICA. Finca Novarro *Maxon* 649; Platanillo, road to Canas Gordas *Pittier* 11194; El General, San Jose *Skutch* 2327, 3088; El Muneco, near Navarro, Cartago *Standley* 33692.

PANAMA. Rio Chiriqui Viejo, Monte Lirio, Chiriqui *Seibert* 309; Chiriqui Viejo Valley *G. White* 106; Rio Chiriqui Valley, Paso Ancho to Monte Lirio *P. H. Allen* 1478.

92. **S. Maxonii** Leon., Contrib. U. S. Natl. Herb. 22: 718, 1927; type collected by Pittier (no. 5406) in the wet forests between Rio Ladrillo and Las Siguas Camp, Cerro de la Horqueta, Chiriqui, Panama (U. S. Natl. Herb.).

A perennial herb as much as a meter tall, more or less decumbent, its stems closely pubescent with spreading hairs, these somewhat thinner in the inflorescence; leaf blades ovate, prevailingly 5–7 cm. long, 3–4 cm. broad, shortly acuminate, rounded at the base, obscurely sinuate, subentire, the upper surfaces hirtellous only on the veins, the lower hispidulous at least along the veins, paler; petioles 1.5–3 cm. long; flowers in racemes 2–4 cm. long; flowering calyces clothed with spreading hairs like the stems and somewhat glandular, the lower lip 4 mm. long at anthesis; corolla red, its galea and tube 26–30 mm. long, the galea about 6 mm. tall, the lower stamens seated about 15 mm. above the base of the tube; nutlets not seen.

Distribution (see map 33).—Known only from the type specimen.

93. **S. Lundellii** Epl., Lilloa 4: 267, 1939; type collected by C. L. Lundell (no. 6867) in the El Cayo region, near Vaquero, British Honduras (U. Mich.).

A perennial herb about 50 cm. tall, the stems hirsute throughout with short subascendent hairs and, particularly in the inflorescence, with longer hairs which may be glandular; leaf blades ovate, 2.5–3.5 cm. long, remotely serrate-crenate above the middle, both surfaces sparingly hirsute with rather long hairs; flowers disposed in racemes about 5 cm. long; flowering calyces 5 mm. long; corolla bright scarlet, the galea and tube 40 mm.

long, the galea 8 mm. tall, the tube gradually enlarged upward; lower stamens seated 26 mm. above the base of the tube; nutlets not seen.

Distribution (see map 33).—Known only from the type specimen.

94. **S. costaricana** Wendl., Hamb. Gart. Zeitschr. 19: 29, 1863; based upon a specimen collected by Wendland in the upper drainage of the Sarayiqui River, Costa Rica; type, if preserved, may be in herb. of Hamb. Bot. Gard.

S. ? argentata Leon., Jour. Wash. Acad. Sci. 17:170, 1927; type collected by Lankester at La Florida, Costa Rica (U. S. Natl. Herb.).

A slender perennial herb as much as 2 meters tall, the stems hirtellous above with upwardly directed hairs, occasionally somewhat glandular in the inflorescence; leaf blades elliptical or ovate-elliptical, 8–14 cm. long, 3–7 cm. broad, acuminate, narrowed toward the base and usually very narrowly and shallowly cordate, their margins subentire or irregularly sinuate-dentate, the upper surfaces glabrous, the lower minutely hirtellous along the veins; petioles 2–4 cm. long; flowers erect, rather crowded in racemes 5–8 cm. long; flowering calyces minutely hirtellous, nearly glabrous, 4.5–5.5 mm. long, not seen at maturity; corolla vermilion (or possibly orange); galea and tube 53–62 mm. long, the former 7–8 mm. tall; lower stamens seated 36–42 mm. above the base of the tube; nutlets not seen.

S. argentata differs only in pubescence, the hairs being somewhat coarser, but wholly capitate-glandular in the infloresence. Its specific identity is doubtful. The small hairs appear on the intervenous tissue of the lower leaf surface, as well as on the veins. Another specimen collected amid average plants at La Hondura, San Jose, Costa Rica, has corollas 40 mm. long.

Distribution (see map 33).—COSTA RICA. La Hondura, San Jose *Standley* 36579, 36594; Valle du Digues between Rio Volcan and Rio Convento *Pittier* 12111; La Palma, road to La Hondura *Maxon and Harvey* 7989; La Florida *Lankester;* forests of Shirores, Talamanca *Tonduz* 9300; no locality *Endress* 201.

95. **S. Mociniana** Benth., Lab. Gen. et Sp. 442, 1834, based upon a specimen collected in Mexico by Mociño and Sessé; type, formerly in Lambert herb., apparently lost (none found in herb. of Univ. Oxf.); an authentic specimen in Madrid Herb.

Perilomia fruticosa Cham. and Schlect., Linnaea 5: 102, 1830, based upon a specimen collected near Jalapa in the Cerro Colorado, Vera Cruz, Mexico, by Schiede and Deppe; probable type in herb. of Bot. Inst. at Berlin, an isotype (annotated by Bentham) in herb. of Royal Bot. Gard. at Kew.

A perennial herb (perhaps fruticose at the base), its slender branches clothed throughout with fine, upwardly curled hairs; leaf blades nearly glabrous, notably paler beneath and hirtellous only on the veins with hairs like those of the branches, ovate-elliptical, 8–12 cm. long, 4–7 cm. broad, acuminate at the apex, rounded or narrowed at the base, borne on petioles 1.5–2.5 cm. long, sinuate-serrate; flowers few in terminal racemes 2–3 cm. long; calyces minutely hirtellous, nearly glabrous, 6 mm. long at anthesis; corolla red, the galea and tube 4.5 cm. long, curved at right angles a third of the way up the tube, the galea about 8 mm. tall, the tube gradually enlarged upward; lower stamens seated about 23 mm. above the base of the tube; nutlets not seen.

Distribution (see map 33).—MEXICO. VERA CRUZ. Cerro Colorado, Jalapa *Schiede* 156; Coatepec *Barnes and Land* 575; Dos Puentos *Liebmann* 15601; Jalapa *Linden* 208; Orizaba *Bourgeau* 2818.

96. **S. formosa** Leon., Contrib. U. S. Natl. Herb. 22: 718, 1927; type collected by Conzatti (no. 2464) in Cerro de la Raya near Cuyamecalco, Cuicatlan, Oaxaca, Mexico (U. S. Natl. Herb.).

A perennial herb (perhaps fruticose at the base), the slender branches quite glabrous below, pubescent above with downwardly curled hairs, these changing to sharp spreading hairs in the inflorescence; leaf blades ovate-elliptical, 8–12 cm. long, 4–7 cm. broad, acuminate at the apex, rounded or narrowed at the base, nearly glabrous, hirtellous with upwardly appressed hairs, sinuate-serrate; petioles 1.5–4 cm. long; flowers few in terminal racemes 5–8 cm. long; calyces minutely hirtellous, nearly glabrous, 4–5 mm. long at anthesis; galea and tube 4.0–9.5 cm. long, curved at right angles about a third of the way up the tube, the galea 5–6 mm. long, the tube gradually enlarged upward; lower stamens about 15–18 mm. above the base of the tube; nutlets not seen.

Distribution (see map 33).—MEXICO. OAXACA. Cerro de la Raya, Cuyamecalco *Conzatti* 2464; La Loma, Cuyamecalco *Conzatti and Gomez* 2465, 2496. GUERRERO. Pie de la Cuesta Toro Muerto, Galeana, in dense oak forest *Hinton* 11073.

97. **S. inflata** Epl., Lilloa 4: 270, 1939; type collected by Türckheim (no. II. 2029) in forests near Coban, Alta Vera Paz, Guatemala (U. S. Natl. Herb.)

A perennial herb about 60 cm. tall, more or less procumbent, hirsute throughout with spreading, rather long hairs, especially in the inflorescence; leaf blades elliptical or ovate-elliptical, prevailingly 8–12 cm. long, 3.5–5 cm. broad, acuminate at the apex, narrowed and rounded at the base, subentire or remotely caliculate, the upper surface sparingly appressed-hirsute, the lower paler, hispidulous throughout with short straight hairs; petioles 1.5–2.5 cm. long; flowers in racemes 5–15 cm. long, subtended by usually persistent bractlets; flowering calyces 4.5 mm. long; corolla bright red, the galea and tube 42 mm. long, strongly curved about 15 mm. above the base of the tube, inflated above but more or less constricted near the lips; lower stamens seated about 20 mm. above the base of the tube; nutlets not seen.

Distribution (see map 33).—GUATEMALA. ALTA VERA PAZ. Coban *Turckheim II* 2029; Pansamala *Turckheim* 1029.

SECTION XIV. Coccineae

Coccineae Epl., Lilloa 4: 270, 1939; type species is *S. coccinea.*

Low herbs usually with a solitary erect stem from a short caudex and fascicle of fleshy roots, usually hirtellous with small hairs, either curled or straight. Leaves ovate or oval, glabrate, the upper surface usually sprinkled with stoutish appressed hairs, the lower hirtellous on the veins, less often hirsute or softly pubescent. Flowers bright red, white in one species or white, tinged with rose. Corollas slender, nearly straight, the tube pubescent within. Nutlets insufficiently known.

KEY TO SPECIES

A. Corolla tube 27–32 mm. long; petioles 2.5–6 cm. long; plants of Loreto, Peru 100. **S. speciosa**

AA. Corolla tube 17–22 mm. long.

B. Calyces, leaves and stems hirsute with rather long hairs; petioles 3–4 cm. long; plants of Peru.......................................104. **S. Hookeri**

BB. Calyces, leaves and stems hirtellous or glandular with short hairs or glabrous; petioles mostly .5–2.5 cm. long.

C. Hairs of stem short and spreading, conical, scarcely glandular; petioles usuaally less than 1 cm. long; leaves broadly ovate; plants of Peru..101. **S. irrasa**

CC. Hairs of stems glandular; petioles 1.5–2.5 cm. long; leaves oblong; plants of Ecuador....................................99. **S. alborosea**

CCC. Hairs of stem curled; petioles mostly 1–3 cm. long; plants nearly glabrous.

D. Leaf blades broadly ovate.

E. Racemes mostly 5–10 cm. long; plants of Peru..102. **S. atriplicifolia**

EE. Racemes 2–4 cm. long; plants of Colombia.......103. **S. umbratilis**

DD. Leaf blades tending to oblong or elliptical rather than ovate; racemes 3–6 cm. long, the flowers crowded; plants of Colombia....98. **S. coccinea**

98. **S. coccinea** Kunth, *in* Humboldt and Bonpland, Voy., Nov. Gen. et Sp. 2: 325, 1817; type collected by Humboldt and Bonpland at the Santa Anna mine near Mariqueta, Colombia; the type is apparently neither at Berlin nor Paris.

A perennial herb as much as 50 cm. tall, with thickened fascicled roots, often decumbent, hirtellous in the upper parts with curled hairs; leaf blades dark green, now ovate, now elliptical, the median 4–10 cm. long, 2–4.5 cm. broad, sometimes rounded at the base, more often rounded and narrowed, obtuse or somewhat acute at the apex, subentire or lightly sinuate-dentate, the upper surface glabrous, the lower minutely hirtellous along the veins, usually purple; petioles 1–2.5 cm. long, racemes 3–6 cm. long, the flowers crowded, irregularly disposed in the axils of persistent linear-lanceolate bracts; pedicels 3–4 mm. long; flowering calyces 3 mm. long, nearly glabrous, the lower lip 4.5 mm. long at maturity, the scutellum then 4 mm. tall; corolla scarlet, its tube 18–20 mm. long, sparingly glandular-hirtellous, gradually enlarged upward; nutlets not seen.

Distribution (see map 32).—COLOMBIA. TOLIMA. Libano *Pennell* 3418. CAUCA. Rio Risaralda *Lehmann* 3315; Rio Paila near Corinto *Pittier* 1010; Patcho forest *Purdie;* Popayan *Lehmann* 4221; Narangal *Lehmann* 3315.

99. **S. albo-rosea** Lemaire, L'Illus. Hort. 16: 584, 1869; type collected by Barraquin on the upper reaches of the Amazon, Ecuador.

A perennial herb as much as 40 cm. tall, with thickened fascicled roots, the stems simple, rather densely glandular-puberulent in the upper parts; leaf blades 6–12 cm. long, 3–5 cm. broad, usually oblong-ovate, shortly and lightly acuminate at the apex, rounded at the base and usually lightly cordate, not at all cuneate, their margins sufficiently convex, sinuate, subentire, apparently undulate, the upper surface glabrous, the lower puberulent chiefly along the veins; petioles 1.5–2.5 cm. long; racemes 5–12 cm. long, the flowers crowded, irregularly disposed in the axils of deciduous linear-lanceolate bracts 4–5 mm. long; flowering calyces 2.5 mm. long, hirtellous with small hairs, the lower lip 5 mm. long at maturity, the scutellum then 5–6 mm. tall; corolla tube 17–18 mm. long, rather slender below and abruptly dilated above; nutlets not seen.

The corollas of Lemaire's figure are white beneath and purple rosy above; Lehmann describes them as "dunkle Kermesinroth," but his specimens appear to have been pale rather than dark; Andre describes them as rosy.

Distribution (see map 32).—ECUADOR. Sigsig, Rio Gualaquiza near the confluence of the Rio Bombaiza *Lehmann* 5430; Palanda *Andre* 4630; Quebrada de Zambanama *Andre* 4630.

100. **S. speciosa** Epl., Rept. Spec. Nov. 85: 175, 1936; type collected by Ule (no. 6580) at the Pongo de Chilcayo near Tarapoto, Loreto, Peru (Kew).

?*S. aurata* Lemaire, L' Illus. Hort. 10, t. 368, 1863.

A perennial herb 30–50 cm. tall with thickened fascicled roots, its stems subsimple, glandular with short spreading hairs, particularly in the upper parts; leaf blades 8–10 cm. long, 4–5.5 cm. broad, ovate, obtuse, rounded at the base or even subcordate, sinuate-dentate, the upper surface dark green, nearly glabrous, sprinkled with appressed hairs, the lower paler, very finely hirtellous along the veins; petioles 2.5–6 cm. long; racemes 5–10 cm. long, the flowers subopposite, crowded, subtended by linear-lanceolate, tardily deciduous bracts; pedicels 4–6 mm. long; flowering calyces 4 mm. long, glandular-pubescent, the lower lip 6.5–7 mm. long at maturity, the scutellum then 6 mm. tall; corolla scarlet, the tube gradually enlarged upward, 27–32 mm. long; nutlets not seen.

Distribution (see map 32).—PERU. LORETO. Tarapoto *Spruce* 4050; Pongo de Chilcayo, Tarapoto *Ule* 6580; Tocache *Poeppig* 1925; Pongo de Cainarachi near Huallaga *Ule* 6580*b;* Rumizapa near Tarapoto *Williams* 6778; San Roque *Williams* 7807.

101. **S. irrasa** Epl., Rept. Spec. Nov. 85: 177, 1936; type collected by Macbride (no. 4086) at Huacachi, near Muna, Huanuco, Peru (Field Mus.).

A perennial herb 30–50 cm. tall with thickened fascicled roots, the stems simple, densely covered above with spreading short hairs; leaf blades 3–5 cm. long, broadly ovate, rather obtuse, rounded at the base or subcordate, their margins rather convex, sinuate-subserrate, both surfaces ashy with short spreading hairs; petioles 6–10 mm. long; racemes 10–15 cm. long, the flowers in the axils of deciduous lanceolate bracts, now opposite, now subverticillate; pedicels 2–2.5 mm. long; flowering calyces 3 mm. long, hirtellous, the lower lip 5 mm. long at maturity, the scutellum then subequal; corolla reddish-purple, its tube 18–22 mm. long; nutlets tuberculate.

Distribution (see map 32).—Peru. Huanuco. Huacachi near Muna *Macbride* 4086; Cormillo *Pearce.*

102. **S. atriplicifolia** Benth., *in* Lindl. Bot. Reg. 18, pl. 1493, 1832; type collected by Pavon in Peru (Univ. Oxf.).

S. Hartwegii Benth., Pl. Hartw. 244, 1846; type collected by Hartweg (no. 1342) near Quito, Ecuador (Kew).

A perennial herb with thickened fascicled roots, the stems 30–50 cm. tall, puberulent in the upper parts with curled hairs and sometimes spreading capitate glands; leaf blades broadly ovate, 4–9 cm. long, 2.5–5 cm. broad, lightly acuminate at the apex or rather obtuse, rounded at the base, their margins rather convex, sinuate-subserrate, sometimes entire, the upper surface glabrous or sparingly hirtellous, the lower very finely hirtellous along the veins, frequently purple; petioles 1–3 cm. long; racemes 5–10 cm. long, shortly hirtellous, the flowers subopposite in the axils of usually persistent bracts; flowering calyces 2.5–3 mm. long, hirtellous, the lower lip 3.5–4 mm. long at maturity, the scutellum then about 4.5 mm. tall; pedicels 4.5 mm. long; corolla reddish-purple, its tube 18–22 mm. long, gradually enlarged upward; nutlets not seen.

Distribution (see map 32).—Peru. Huanuco. Pozuzo *Macbride* 4554. Junin. Rio Briedo near La Merced *Killip and Smith* 23585; Azupizu to Santa Rosa *Killip and Smith* 26132; Rio Paucartambo near Purene bridge *Killip and Smith* 25353. Ayacucho. Rio Apurimac near Kimpitiriki *Killip and Smith* 22879.

Ecuador. Quito *Jameson* 537; *Hartweg* 1342.

103. **S. umbratilis** sp. nov.; type collected by J. Cuatrecasas in the dense forest of La Hondonada, Salto de Tequendama, Cundinamarca, Colombia (Univ. Calif., L. A.).

Herba perennis altitudine circiter 40 cm., caulibus utrimque pilis parvis ascendento-appressis sat dense pubescentibus, nullomodo glandulosis; foliorum laminis late ovatis 4–7 cm. longis, 2.5–4 cm. latis, in apice breviter acuminatis, in basi rotundatis et subcordatis, marginibus convexiusculis, sinuato-subserratis, subintegris, pagina superiore sparse hispidula inferiore solum ad venas pilis parvis curvis hirtella; petiolis 1–2 cm. longis; racemis 2–4 cm. longis ascendento-hirtellis, floribus suboppositis bracteis minutis linearibus subtentis; calycibus florentibus 2.5 mm. longis, extus ascendento-hirtellis, in maturitate non visis; pedicellis 3–4 mm. longis; corollarum coccinearum galea cum tubo 22–23 mm. longo, superne gradatim ampliato, leniter arcuato.

Distribution (see map 32).—Known only from the type collection.

104. **S. Hookeri** Epl., Rept. Spec. Nov. 85: 178, 1936.

S. villosa Hook., Bot. Mag. 80: pl. 4789, 1854 (not Ell., Bot. N. C. and Ga. 2: 94, 1824); type a cultivated specimen from Peruvian seeds sent by Nation (Kew).

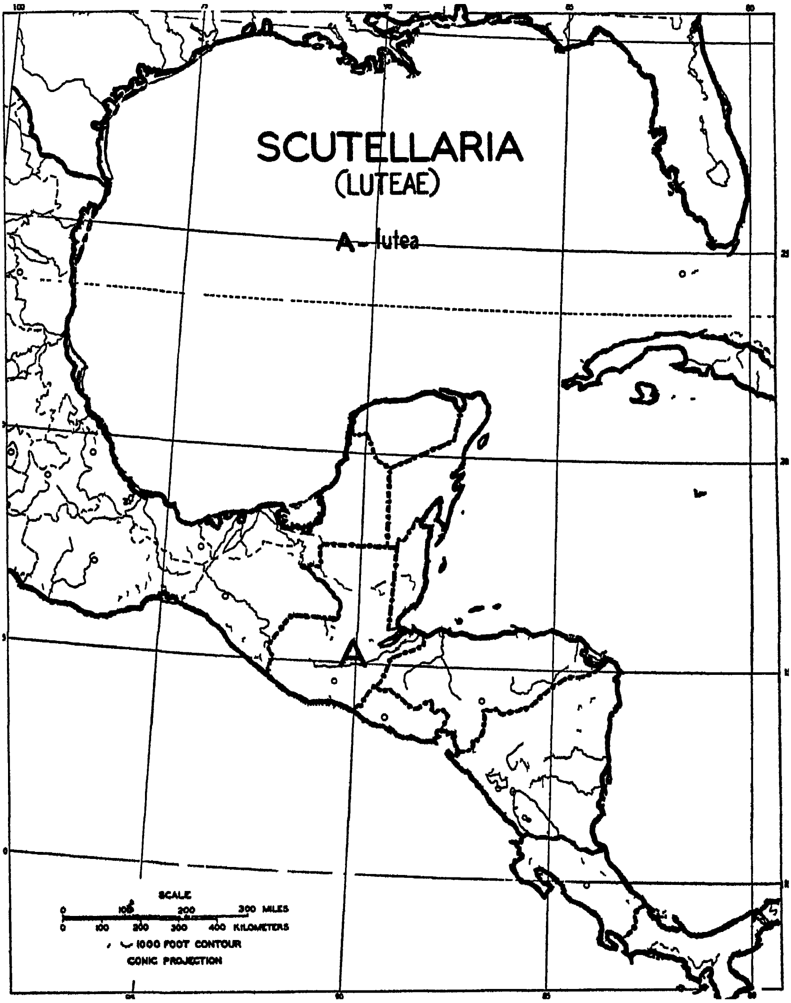
A perennial herb 20–30 cm. tall, its stems softly pilose or villous with rather long spreading hairs; leaf blades 6–10 cm. long, 3.5–6 cm. broad, ovate, rather obtuse, rounded at the base, their margins subentire, sinuate-dentate, both surfaces softly pilose-villous; petioles 3–4 cm. long; racemes villous, the flowers crowded, subopposite in the axils of tardily deciduous oblong-lanceolate ciliate bracts; flowering calyces 3.5 mm. long, sparingly clothed with long spreading hairs, the lower lip 4.5–5 mm. long at maturity, the scutellum then about 6 mm. tall; corolla scarlet, its tube 20–22 mm. long, gradually enlarged upward; nutlets papillate.

Distribution (see map 32).—PERU. In dense forest near Lake Cassopilla near Pampanacio *Poeppig* 1535.

SECTION XV. Luteae

Luteae Epl., Lilloa 4: 271, 1939; the type species is *S. lutea.*

Suffrutescent twiggy herbs, softly hirsute throughout. Leaves oval or ovate, petiolate. Flowers opposite in short racemes or the lower in the axils of but slightly diminished leaves. Scutellum well-defined. Corolla said to be yellow, hairy, its tube hairy within, gently arcuate, the lips close. Lower stamens seated above the middle of the tube. Nutlets unknown. Resembles section *Perilomioideae* in many ways, differing significantly in the position of the stamens and the impressed scutellum.



Map 34. Distribution of *S. lutea.*

105. **S. lutea** J. D. Smith, Bot. Gaz. 13: 76, 1888; type collected by Türckheim (no. 1309) near Santa Rosa, Guatemala (U. S. Natl. Herb.).

A suffrutescent herb, its branches hirsute with spreading sharp hairs; leaf blades mostly oval or ovate, mostly 2–3 cm. long, 1–2 cm. broad, obtuse, more or less rounded at the base, irregularly crenate-serrate, both surfaces softly hirsute with spreading hairs; petioles 3–10 mm. long; flowers mostly in short racemes 1–3 cm. long; flowering calyces clothed like the leaves, the lower lip 4–5 mm. long, about 6 mm. at maturity, the scutellum erect, impressed; corolla said to be yellow, its galea and tube 24–26 mm. long, the galea about 4 mm. long, the lower stamens seated 14–15 mm. above the base of the tube; nutlets not seen.

Distribution (see map 34).—GUATEMALA. BAJA VERA PAZ. Salama, Santo Thomas *Seler* 3406; Santa Rosa *Türckheim* 1309; Cuesta de Cachil, Salama *Pittier* 148.

SECTION XVI. **Perilomioideae**

Perilomioideae Epl., Rept. Spec. Nov. 85: 178, 1936.

Subsect. *Perilomioideae* Benth. DC. Prodr. 12: 430, 1848. The type species is *S. gardoquioides.*

Well-branched half-shrubs with small leaves, softly pubescent, with longer more or less spreading hairs, less often hirtellous with small curled hairs, or branched in *S. sarmentosa.* Flowers axillary in the axils of more or less diminished leaves or subracemose. Corollas scarlet, purplish, or yellowish, often quite hairy, the tubes lightly arcuate, hairy within, the lips short and seemingly open. Lower pair of stamens seated below the middle of the tube, toward the base, the upper at about the same level or at about the middle. Upper lip of calyx produced into the usual scutellum or simply concave and subconical but not impressed. Nutlets usually verrucose.

KEY TO THE SPECIES

A. Branchlets clothed with branched hairs; corolla tube 35 mm. long; plants of Ecuador 110. **S. sarmentosa**

AA. Branchlets clothed with simple hairs; corolla tube 8–18 mm. long; plants of Peru, one species also in Ecuador.

  B. Upper lip of mature calyx subconical or subpyramidal, not compressed, about equal to the lower lip; corolla tube 15–18 mm. long; hairs of stem spreading, the leaves hirsute..106. **S. volubilis**

  BB. Upper lip of mature calyx impressed to form an erect transverse scutellum.

    C. Leaves softly tomentose beneath, especially the uppermost; corolla tube 8 mm. long; flowering calyces albotomentellous................107. **S. tomentosa**

    CC. Leaves hirtellous with short spreading hairs; corolla tube 9–13 mm. long; calyces hirtellous.

      D. Corolla tube 9 mm. long; stems clothed with short straight spreading hairs; leaves 6–12 mm. long..................108. **S. gardoquioides**

      DD. Corolla tube 10–13 mm. long; stems clothed with small appressed hairs; leaves 1–2.5 cm. long..........................109. **S. Benthamiana**

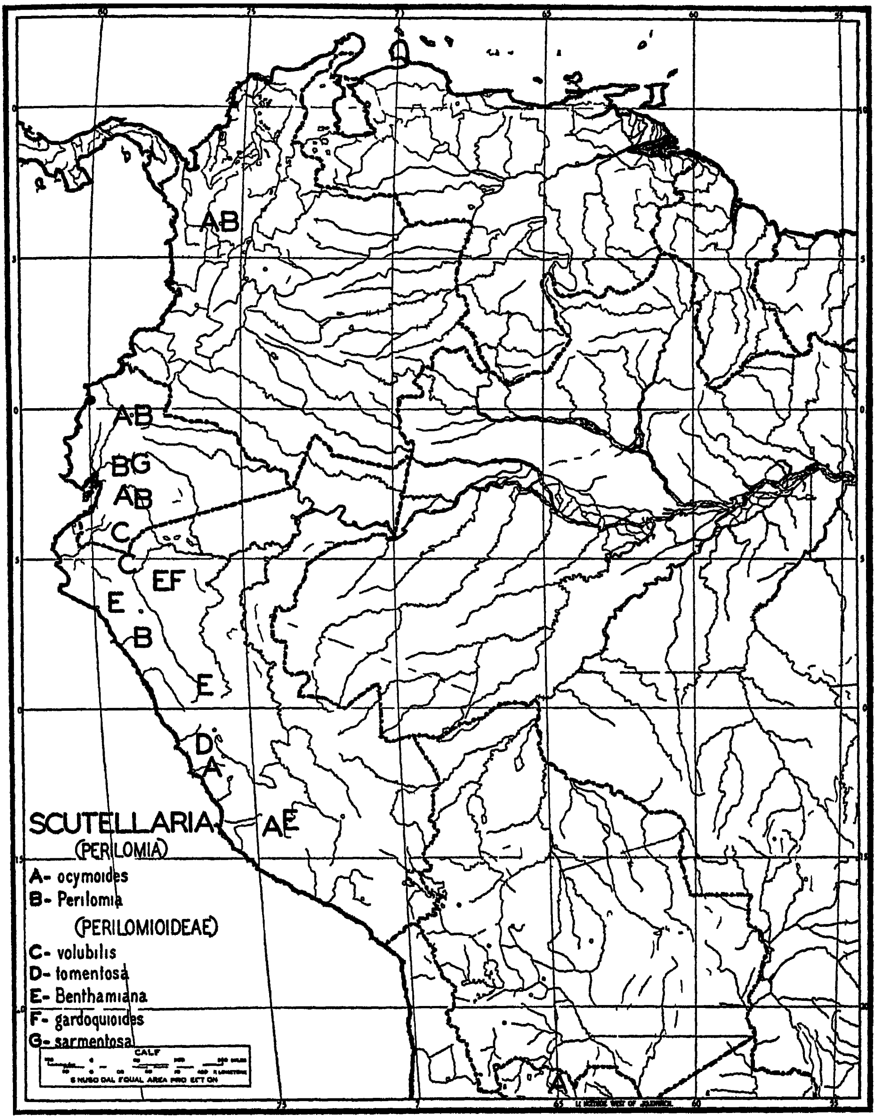
106. **S. volubilis** Kunth, *in* Humboldt and Bonpland, Voy., Nov. Gen. et Sp. Pl. 2: 325, 1817; type collected by Humboldt and Bonpland (no. 3326) near Loja, Ecuador (Paris).

S. cumanensis Kunth, loc. cit.; type collected by Humboldt and Bonpland between Cumana and Bordones (Paris).

Perilomia volubilis and *cumanensis* Briq., *in* Engl. u. Prantl, Nat. Pflanzenf., ed. 1, IV: 3a, 233, 1897.

P. Briquetiana Mansf., Bot. Gart. Berlin-Dahl., Notizbl., 9: 284, 1925; type collected by Weberbauer (no. 6337) in the Cordillera Guamani near Huancabamba, Peru (Berlin).

P. palamblaensis Mansf., l. c.; type collected by Weberbauer (no. 6027) above Palambla, near Huancabamba, Peru (Berlin).



Map 35. Distribution of the sections *Perilomia* and *Perilomioideae*.

A half-shrub as much as a meter tall, its branches clothed with spreading hairs, the median internodes 2–5 cm. long; leaf blades 1.5–3 cm. long, rugose, rotund-ovate or ovate, obtuse or rounded at the apex, rounded-truncate or truncate-cuneate at the base, their margins crenate, the upper surface sparingly hirtellous, the lower more densely, paler, even subtomentose, the hairs spreading and straight, not curled; flowers opposite in the axils of diminished leaves, disposed on short lateral branches 2–3 cm. long; flowering calyces 2.5–3 mm. long, hirsute with spreading hairs, both lips subequal at maturity, 3.5–4.5 mm. long, equally concave, the upper not impressed into an erect scutellum; pedicels 2.5–3 mm. long; corolla scarlet, its tube 15–18 mm. long, hirsute, densely pilose within around the base of the stamens, the shorter pair of stamens seated near the middle of the tube, long decurrent, the longer pair seated about 4 mm. above the base of the tube; nutlets papillate.

Distribution (see map 35).—PERU. HUANCABAMBA. Near Palambla *Weberbauer* 6027; Cordillera Guamani *Weberbauer* 6337.

ECUADOR. Loja *Rose* 23281, 23894; *Seeman* 716; *Andre* K1566; *Lobb; Lehmann* 4952, 4953; *Bonpland* 3326; *Warszewisz* 2.

107. **S. tomentosa** Epl., Rept. Spec. Nov. 85: 179, 1936.

Perilomia tomentosa Benth., Lab. Gen. et Sp. 446, 1834; type collected by ?Dombey at Cheuchin, Peru (Univ. Oxf.).

A shrub or half-shrub with lightly marginate branches which are albotomentose in the upper parts, the median internodes 1–3 cm. long; leaf blades 1–3 cm. long, 7–21 mm. broad, ovate, generally obtuse at the apex, the upper rather acute, rounded at the base or even subcordate, their margins crenate-serrate or those of the uppermost subentire, the upper surface hirtellous, the lower albotomentose with tangled hairs; petioles tomentose, 2–5 mm. long; flowers opposite in the axils of diminished leaves; pedicels about 1 mm. long; flowering calyces densely albotomentellous, about 3 mm. long, glabrous within; lower stamens seated about 2.5 mm. above the base of the tube; nutlets acutely papillose.

The type of this species, distributed by Pavon, was ascribed to Mexico by Bentham. It was more probably part of Dombey's collection.

Distribution (see map 35).—PERU. Cheuchin *Dombey* (Pavon).

108. **S. gardoquioides** Benth., DC. Prodr. 12: 430, 1848; type collected by Mathews near Chachapoyas, Peru (Kew).

Perilomia gardoquioides Benth. and Hook., Gen. Pl. 2: 1203, 1876.

An intricately branched shrub, its branchlets ashy with short spreading hairs, their internodes 1–3 cm. long; leaf blades 6–12 mm. long, ovate or oval, rounded at both ends, subentire, the upper surface sparingly hirtellous, the lower paler, pubescent with short spreading hairs, especially along the veins; petioles 3–4 mm. long; flowers disposed in the axils of diminished leaves toward the tips of short branchlets; pedicels 2–3 mm. long, each bearing a pair of bracteoles; flowering calyces 2.5 mm. long, hirtellous, the lower lip 3–3.5 mm. long at maturity, the upper then about 3 mm. tall; corolla ?red, tube yellowish-hirsute, 9 mm. long, gradually enlarged upward, hirsute at the base of the stamens; lower stamens seated about 3 mm. above the base of the tube, the upper bearing small appendages near the base, hirsute above; nutlets verrucose.

Distribution (see map 35).—PERU. AMAZONAS. Chachapoyas *Mathews*.

109. **S. Benthamiana** Epl., Rept. Spec. Nov. 85: 179, 1936.

Perilomia Benthamiana Mansf., Bot. Gart. Berlin-Dahl., Notizbl., 9: 285, 1925; type collected by Weberbauer (no. 6164) between the Tabaconas and Maranon rivers, Cajamarca, Peru (Berlin).

A fragrant shrub as much as a meter tall, intricately branched, its branches hirtellous with appressed hairs, angled; leaf blades 1–2.5 cm. long, ovate, obtuse at the apex, rounded at the base, subentire, the upper surface nearly glabrous, the lower hirtellous with short appressed hairs; petioles 3–5 mm. long; flowers disposed in the axils of diminished leaves toward the tips of short branchlets; pedicels 2–3 mm. long; flowering calyces hirtellous, 3–4 mm. long, the lower lip 5–5.5 mm. long at maturity, the scutellum then subequal; pedicels 5–6 mm. long; corolla sulphur-yellow, its tube 10–13 mm. long, hirsute within at the base of the stamens; lower stamens seated 3–4 mm. above the base of the tube, the upper bearing small appendages near the base; nutlets verrucose.

Distribution (see map 35).—PERU. AMAZONAS. Dunia to Chachapoyas *Raimondi* 168, 179; Collalate *Jelski* 113. CAJAMARCA. Between the Tabaconas and Maranon rivers *Weberbauer* 6164; San Miguel *Weberbauer* 3900. HUANUCO. Llata *Macbride and Featherstone* 2246. AYACUCHO. Huanta *Weberbauer* 7592; *Vidal-Senege* 4798; *Pearce*.

110. **S. sarmentosa** Epl., Rept. Spec. Nov. 85: 180, 1936; type collected by Spruce on Chimborazo in the descent from Llullundango, Ecuador (Kew).

A shrub or half-shrub as much as 4 m. tall, its branches slender and floccose with branched hairs which appear to be yellowish; internodes 3–6 cm. long; leaf blades ovate, 2–3 cm. long, 12–18 mm. broad, obtuse at the apex, cuneately narrowed at the base to floccose petioles 5–8 mm. long, nearly glabrous on the upper surfaces, the lower floccose with branched hairs, the veins rather prominent; flowers solitary in the axils of diminished leaves, disposed in racemes 2–3 cm. long; flowering calyces 7 mm. long, floccose with branched hairs, the orifice subtruncate, the scutellum small, not seen at maturity; corolla purplish, its tube 35 mm. long, lightly arcuate, gradually enlarged upward, densely villous within toward the base of the stamens, the lips about 5 mm. above the base of the tube; nutlets not seen.

So far as I am aware this is the only *Scutellaria* which bears branched hairs. Its habit is also distinctive. When the species is better known, it may preferably be separated from this section.

Distribution (see map 35).—ECUADOR. Chimborazo, below Llullundango *Spruce*.

SECTION XVII. Perilomia

Perilomia Epl., Rept. Spec. Nov. 85: 178, 1936. The type species is *S. Perilomia*.

Perilomia (as genus) Kunth, *in* Humboldt and Bonpland, Voy., Nov. Gen. et Sp. Pl. 2: 326, 1817; type species, *P. scutellarioides*.

Perilomia sect. *Euperilomia* Briq., *in* Engler u. Prantl, Nat. Pflanzenf. 4, 3a: 233, 1897; type species, the same.

Perilomia sect. *Holocraspeda* Briq., l.c.; type species, *P. ocymoides*.

Half-shrubs or herbs, more or less twining, nearly glabrous, with ovate, petiolate leaves. Flowers mostly disposed in leafy racemes, subtended by entire but leaflike bracts. Corolla brilliant scarlet, hairy, the tubes lightly but clearly flexuose, hairy within, the lips short, seemingly open. Both pairs of stamens seated below the middle of the tube. Upper lip of calyx concave, both lips equally concave at maturity. Nutlets angled and lacerate-marginate.

When better known, the sections *Perilomia, Theresa,* and *Perilomioideae* may be hardly separable; or some of the species may preferably be segregated as the genus *Perilomia,* primarily on the basis of corolla structure. The data are as yet insufficient, and I have retained all in *Scutellaria*.

KEY TO THE SPECIES

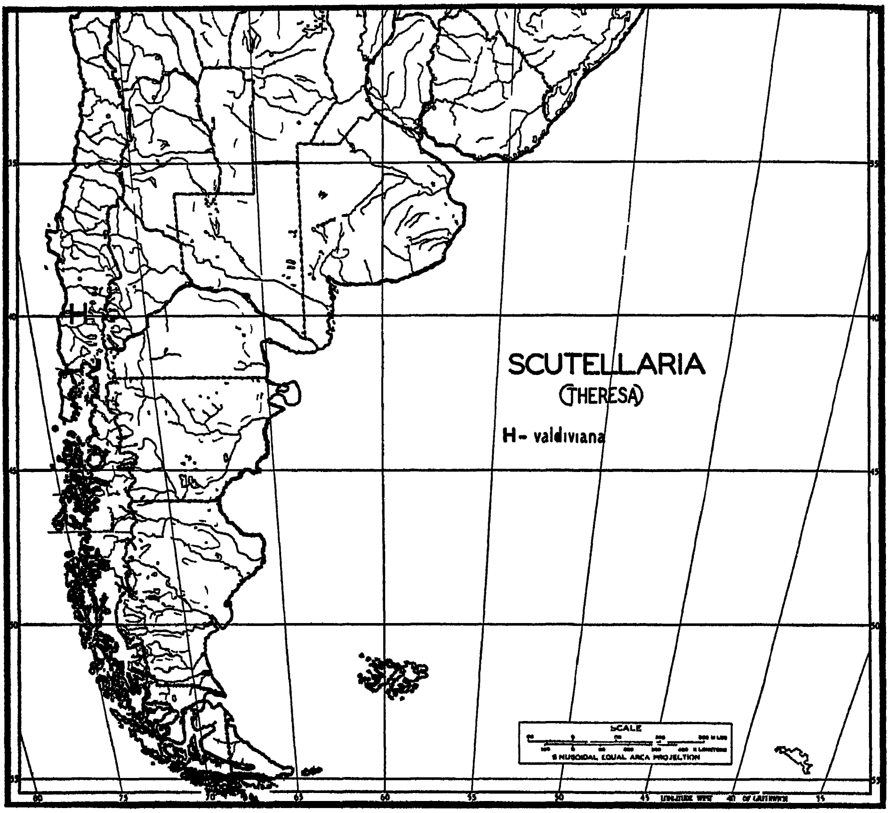
A. Corolla tube 12–14 mm. long.................. ....111. **S. ocymoides**
AA. Corolla tube 7–8 mm. long...112. **S. Perilomia**

111. **S. ocymoides** Epl., Rept. Spec. Nov. 85: 178, 1936.

Perilomia ocymoides Kunth, *in* Humboldt and Bonpland, Voy., Nov. Gen. et Sp. Pl. 2: 328, 1817; type collected by Bonpland (no. 3232) near Alausi, Ecuador (Berlin).

P. Weberbaueri Mansf., Bot. Gard. Berlin-Dahl., Notizbl., 9: 283, 1925; type collected by Weberbauer (no. 5813) near Coracora, Peru (Berlin).

A pretty half-shrub probably diffuse and subscandent or sprawling, its branches slender, marginate, hirtellous, purplish; median leaf blades 3–4 cm. long, ovate or rotund-ovate, shortly acuminate, rounded at the base, their margins rather convex, serrate-crenate, the upper surfaces glabrous, the lower hirtellous along the veins; petioles slender, 5–8 mm. long; flowers opposite in the axils of entire diminished leaves, disposed in panicled racemes; pedicels 1–2 mm. long; flowering calyces purple, 3.5–4 mm. long, hirtellous, the lips subequally concave, 6–7 mm. long at maturity; corolla scarlet, hirsute, its tube 12–14 mm. long, recurved-ascendent, pubescent within at the base of the stamens, stamens seated about 5 mm. above the base of the tube; pilose below the middle; nutlets angled, the angles lacerate-dentate.



Map 36. Distribution of *S. valdiviana.*

Distribution (see map 35).—COLOMBIA. CUNDINAMARCA. Near Caguega, Bogota *Triana.* ECUADOR. Quito *Hall; Alausi Bonpland* 3232.

PERU. AYACUCHO. Coracora *Weberbauer* 5813; between Narquinia and Mancona *Weberbauer* 53. Lima. Matucana *Macbride and Featherstone* 199; Canta *Pennell* 14354; Chillon near Obrajillo *Pennell* 14323; without data *McLean; Dombey.*

ARGENTINA. SALTA. Pampa Grande *Spegazzini* 1673, 1676.

112. S. Perilomia Epl., Rept. Spec. Nov. 85: 178, 1936.

Perilomia scutellarioides Kunth, *in* Humboldt and Bonpland, Voy., Nov. Gen. et Sp. Pl. 2: 327, t. 157, 1817; type collected by Jos. de Jussieu in Ecuador (Paris). According to the International Rules, the name I proposed above has no validity, and a new combinations is required. I prefer, however, to avoid repetitive combinations.

A pretty half-shrub probably diffuse and subscandent or sprawling, its branches slender, marginate, hirtellous, purplish; median leaf blades 3–4 cm. long, ovate or rotund-ovate, shortly acuminate, rounded at the base, their margins rather convex, serrate-crenate, the upper surfaces glabrous, the lower hirtellous along the veins; petioles slender, 8–12 mm. long; flowers opposite in the axils of entire diminished leaves, disposed in panicled racemes; pedicels 2–3 mm. long; flowering calyces purple, 3–3.5 mm. long, hirtellous, the lips subequally concave at maturity, 5.5–6 mm. long; corolla scarlet, hirsute, the tube 7–8 mm. long, recurved-ascendent, pubescent within at the base of the stamens; stamens seated about 3 mm. above the base of the tube, pilose below the middle; nutlets angled, the angles lacerate-dentate.

This species, distinguished from *S. ocymoides* chiefly by the smaller calyces and larger flowers, may represent only an extreme of that species.

Distribution (see map 35).—COLOMBIA. CUNDINAMARCA. Ubola near Bogota *Triana*.

ECUADOR. Quito *Jameson* 145; Cumbe *Rose* 22960; Molleluro and Huasi-huaico *Lehmann* 6483; Guaranda *Andre* 3932; *Spruce* 6225; without locality *Lobb*.

PERU. LIBERTAD. Hacienda de Chuquesonga *Raimondi* 990.

SECTION XVIII. Theresa

Theresa Epl., Rept. Spec. Nov. 85: 180, 1936.

Theresa (as genus) Clos, *in* Gay, Hist. Chili, Bot. 4: 497, 1849. The type species is *S. valdiviana*.

In habit this section is similar to *Perilomia*, the leaves somewhat leathery, subentire, more or less clasping. Flowers in bracteate racemes similar to *Perilomia*. Corolla red, quite glabrous, and the tube nearly straight, apparently glabrous within, the lower lip fairly long, seemingly open; lower stamens seated near the base of the tube. Upper lip of calyx with a squama, unknown at maturity. Nutlets unknown.

113. **S. valdiviana** Epl., Rept. Spec. Nov. 85: 180, 1936.

Theresa valdiviana Clos, *in* Gay, Hist. Chili, Bot., 4: 497, 1849; type a cultivated specimen (Paris).

A pretty shrub perhaps scandent or sprawling, with slender flexible branches which are ashy with short spreading hairs, their internodes 2–5 cm. long; leaf blades leathery, rotund-cordate, 2–4 cm. in diameter, entire or sparingly denticulate, the upper surface glabrous, shining, the lower evenly and softly hirtellous; petioles 2–3 mm. long; flowers opposite in the axils of abruptly diminished entire leaves or leaflike bracts, disposed in racemes 3–10 cm. long; pedicels 2.5–4 mm. long; flowering calyces purple, nearly glabrous, 4–4.5 mm. long, the lower lip 5 mm. long at maturity, the scutellum then 5–6 mm. tall; corolla reddish-purple, the tube about 15 mm. long, ample, glabrous; stamens seated about 4 mm. above the base of the tube; nutlets not seen.

Distribution (see map 36).—Known only from the type collection.

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PLATE 1

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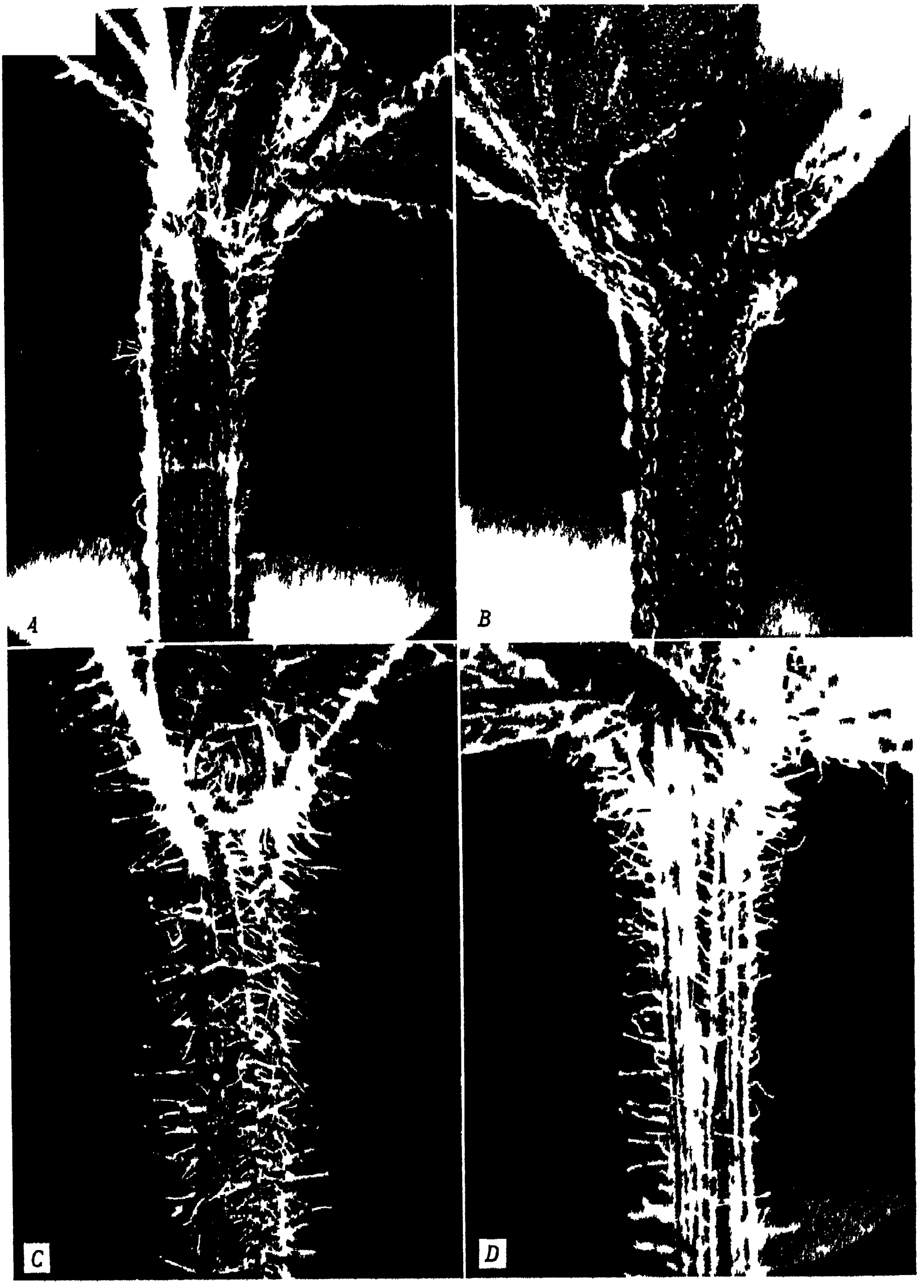
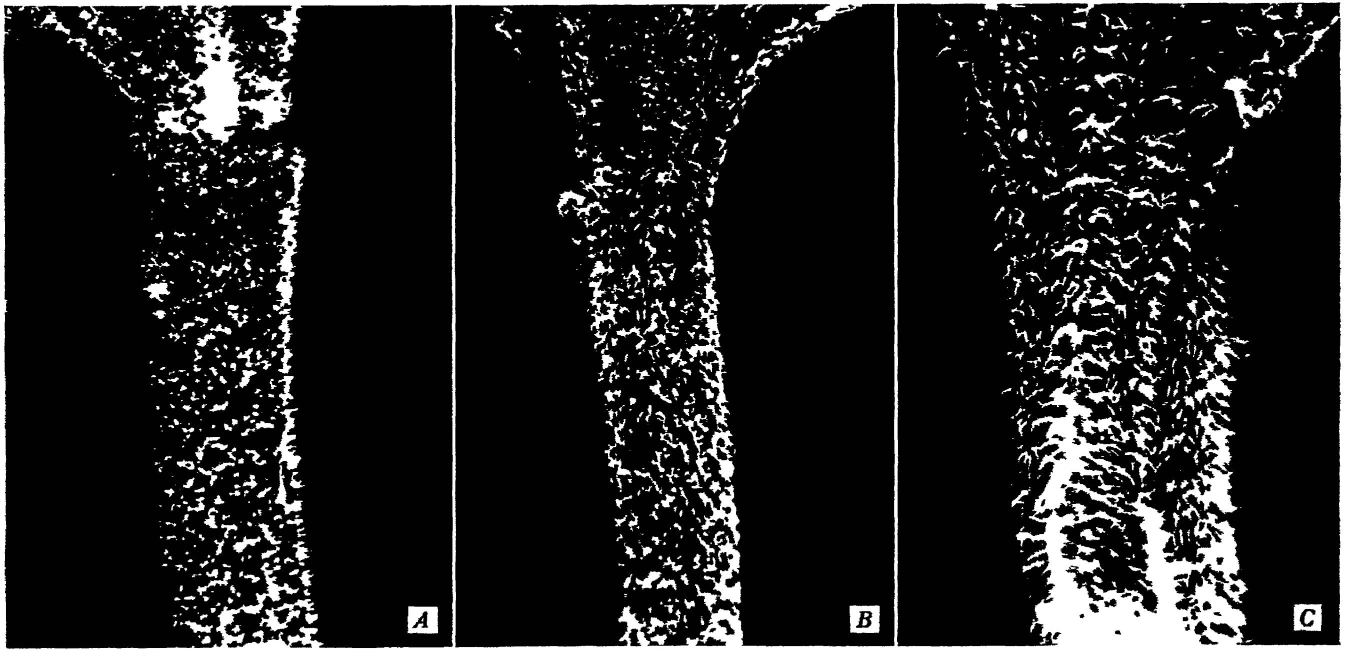

A
B
C
D

PLATE 2

Microphotographs of the pubescence of (*A*) *S. resinosa*, (*B*) *S. Wrightii*, (*C*) *S. tessellata*. The hairs of the first are short and spreading, of the second appressed, and of the third larger and decurved.


A
B
C

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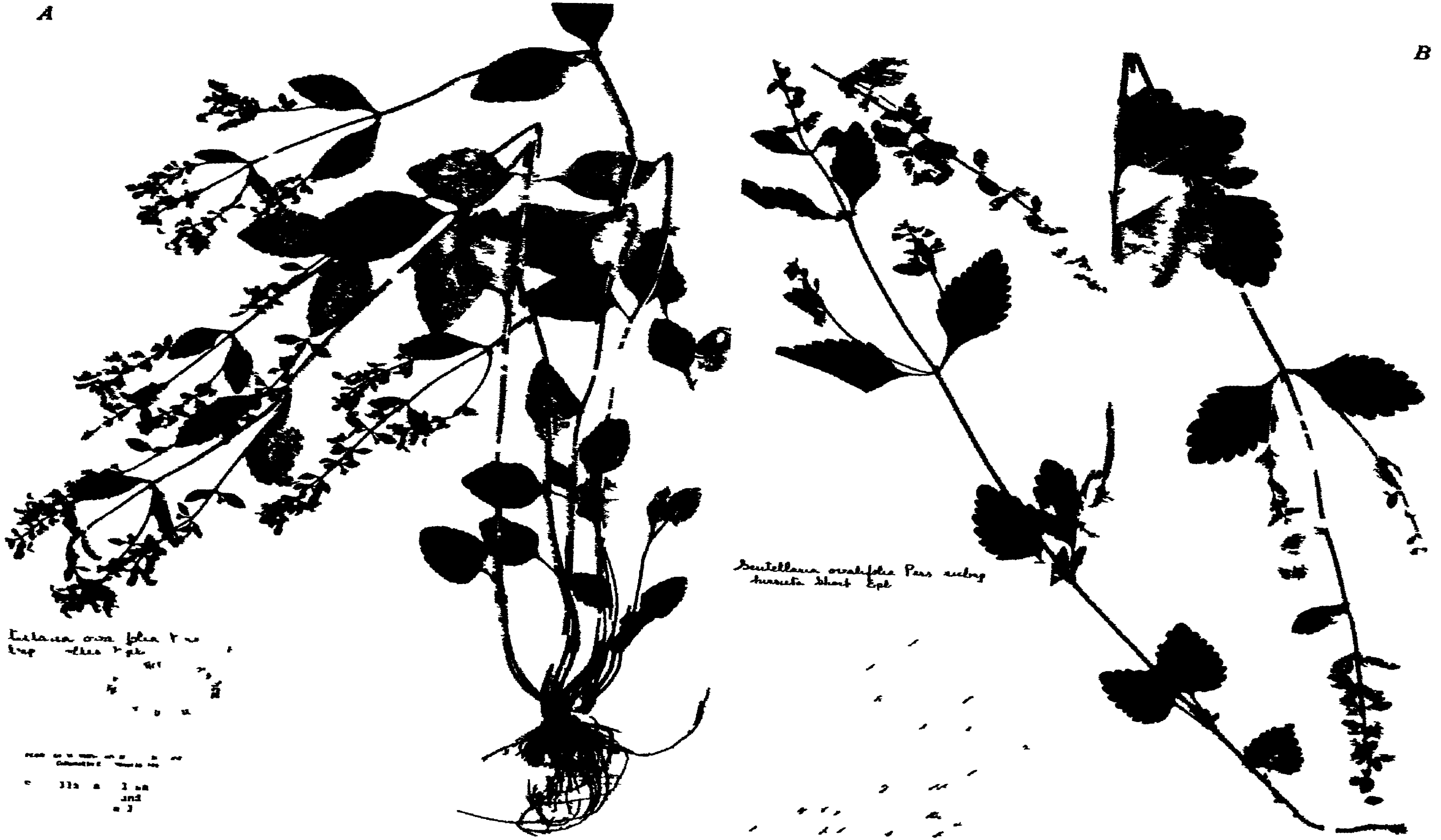
A
B
Scutellaria ovalifolia Pers subsp hirsuta Short Epl

A REVIEW OF THE GENUS MONARDA (LABIATAE)

BY

ELIZABETH McCLINTOCK AND CARL EPLING

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INTRODUCTION

THE GENUS MONARDA is abundant within its range and is frequently collected. Its representation within herbaria is correspondingly large. Nevertheless by reason of its complexity, particularly of the subgenus *Eumonarda,* any survey which is based upon the herbarium method alone is bound to be no more than tentative and suggestive. At the same time, more detailed and intensive study which confined itself solely to a restricted region and failed to consider all of the species within either subgenus would probably fail to give an adequate description of the processes which are at work. Because of the tentative and suggestive nature of the present survey, the names which are formally changed or proposed are as few as seems commensurate with clarity.

A study of the genus was begun as early as 1923 by the senior author while still a student at the Missouri Botanical Garden. Later, as opportunity was offered, the collections in European herbaria were studied, particularly the types, and in 1935 a short review of *Cheilyctis* was published by him (Madroño 3: 20–21, 1935). More recently and at his suggestion the subgenus *Eumonarda* was studied by Miss McClintock and the results were submitted to the Graduate School at the University of California (Los Angeles) in partial fulfillment of the degree of Master of Arts. The subgenus *Cheilyctis* was then reviewed jointly.

The authors are indebted to the several European herbaria which were consulted: the Royal Botanic Gardens at Kew, the British Museum, the National Herbarium at Paris, the Botanical Institute at Berlin, the National Museum at Vienna, the National Museum at Brussels and the Delessert Herbarium at Geneva, and are particularly indebted to the United States National Herbarium, the Gray Herbarium, the Missouri Botanical Garden, the New York Botanical Garden, the Field Museum, the Philadelphia Academy of Natural Sciences, the herbarium of Oberlin College, the Rocky Mountain Herbarium, the University of Wisconsin, the University of Tennessee, the Catholic University of America, the Kansas State College, the Agricultural and Mechanical College of Texas, and the herbarium of Colorado College.

The authors make grateful acknowledgment to the officials of all these institutions. They are also indebted to Mr. Charles Deam, Mr. V. L. Cory, Dr. Forrest Shreve, Mr. H. S. Gentry and Dr. D. C. Correll who kindly submitted their private collections for study. Acknowledgment of indebtedness for generous financial support is gratefully made to the Board of Research of the University of California and to the Works Progress Administration of the United States, to the personnel of which must be credited the preparation of maps and drawings and a wealth of clerical work.

GENUS **Monarda**

Monarda L., Gen. Pl., ed. 1, 6, 1737; ed. 5, 14, 1754; Sp. Pl. 1: 22, 1753. The lectotype is *M. fistulosa.*

Herbaceous perennials of intermediate size with creeping rhizomes, or sometimes annual, their stems simple or branched, variously pubescent with simple hairs, rarely glabrous; leaves ovate, sometimes deltoid, ovate-lanceolate, oblong, elliptical or even linear, usually serrate, rarely subentire, sessile or petiolate; flowers borne in dense glomerules which may be terminal and solitary or several in an interrupted spike, subtended by an involucre of bracts of which the outer are usually foliar, the inner more or less modified, even linear or acicular; calyces tubular, 13–15 veined, the orifice glabrous or hirsute, the teeth relatively short, or equaling the tube, deltoid, subulate or aristate; corolla strongly bilabiate, the upper lip either erect, linear and in continuation of the tube, or falcate, forming a sickle-shaped corolla; stamens seated within the funnel-shaped throat, ascending under the upper lip, exserted or included within it; anthers divaricate; style exserted, the posterior branch shorter; nutlets oblong, smooth.

KEY TO THE SUBGENERA

Heads solitary and terminal, rarely two; upper lip of the corolla somewhat arcuate, but usually erect and in continuation of the tube, the expanded portion of the tube, the throat, as long as or longer than the cylindrical part; stamens exserted beyond the upper lip; leaves ovate or ovate-lanceolate ....1. **Eumonarda**

Heads two or more, forming an interrupted spike; corolla sickle-shaped when viewed laterally because of the markedly falcate upper lip; expanded portion of the corolla tube usually shorter than the cylindrical part; stamens usually not exserted from under the upper lip (but see *M. mexicana*); leaves elliptical or oblong, even linear, less often ovate-lanceolate ....2. **Cheilyctis**

1. SUBGENUS **Eumonarda**

Sect. *Eumonarda* Benth., Lab. 726, 1835. The lectotype of the genus, *M. fistulosa,* may be taken as the standard species.

Perennial herbs, usually spreading by rhizomes, the stems erect; leaves of intermediate size, commonly ovate, or deltoid-ovate, less often ovate-lanceolate, the petioles proportionately short, glomerules terminal, hemispheric, subtended by usually colored bracts which are reflexed wholly or in part, usually forming an involucre partly enclosing the calyces, the outer subfoliar; calyx 13-veined, the teeth subulate, equal, usually not much longer than the width of the tube, never aristate; corolla tube slender, gradually enlarged upward especially above the middle, the throat usually as long as or longer than the cylindrical portion, the upper lip narrow, erect or lightly curved, usually shorter than the lower lip, the limb much shorter than the tube; stamens seated within the throat, somewhat curved and ascending under the galea, lightly exserted; upper style branch usually shorter than the lower.

An abstract of the distribution of the species of this subgenus is shown in figure 1.

Vegetative habit of the section.—The growth form of *Eumonarda* is that of a herbaceous perennial with underground spreading rhizomes which often form clumps. The matured stems range from 30–135 cm. in height. They may be either consistently simple or branched above the middle in some species, while in others they may be both branched and simple. The largest leaves are always median, and vary in shape from lanceolate to ovate or deltoid-ovate. Their margins may be serrate or subentire. The petioles may be absent, and the leaves therefore sessile and even clasping, or they may be as long as 4 cm. The stems and leaves are variously pubescent. Glabrous forms are rare. The pubescence may be of two types: of short and downwardly curled hairs, or of longer pili which are spreading. Both types vary in density. In *M. fistulosa, M. menthaefolia,* and *M. Lindheimeri* both types may be combined.

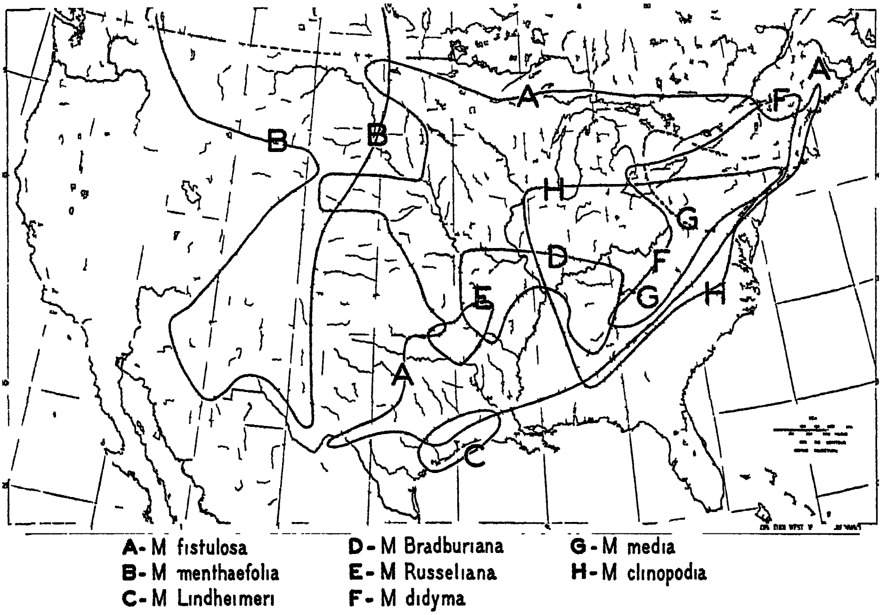

Fig 1. Limits of distribution of each of the species of *Eumonarda,* except *M. Bartlettii* and *M. Pringlei.* Collections recently made place *M. Russeliana* also in Kentucky.

A correlation seemingly exists in some species between the height and branching of the stem, the shape of the median leaves and the length of the petioles. *M. Bradburiana, M. menthaefolia,* and *M. Lindheimeri* usually have simple stems ranging from 30–75 cm. in height, ovate or ovate-lanceolate leaves, and petioles less than 1 cm. in length, while *M. fistulosa, M. didyma, M. clinopodia,* and *M. media* usually have branched stems which may be as tall as 135 cm., ovate-lanceolate to deltoid-ovate leaves, and petioles longer than 1 cm.

Floral habit of the section.—The glomerules are prevailingly solitary and terminal and vary in diameter from 1.5–3 cm., excluding the corollas. Only rarely, notably in *M. didyma,* do two occur. The outer bracts do not present any notable variation. They are subfoliar, reflexed or spreading, and may be green or tinted the same color as the corollas. They are pubescent with the same kind of hairs as the leaves. The flowers usually form a compact mass and are sessile or nearly so. In *M. Lindheimeri,* however, the branches of the glomerules are evident and the flowers are loosely arranged on pedicels which are usually 2–3 mm. long.

The calyces show little variation except in respect to size. The total length of the calyces ranges from 6–16 mm. There is marked overlapping in extremes of length among all of the species, but the means for most species are different. The length of the calyces is generally correlated with the length of the corollas. The length of the calyx teeth is somewhat more significant than the length of the calyx, particularly in *M. Russeliana, M. Pringlei,* and *M. Bradburiana.* In *M. Bradburiana* the teeth are usually 3–4 mm. long, narrowed at the base and acicular. They occasionally bear small stalked glands. *M. Russeliana* and *M. Pringlei* have calyx teeth 2 mm. long. Although actually shorter, the teeth in these species are notably wider at the base than in *M. Bradburiana* and always bear stalked capitate glands. In *M. Bartlettii* the teeth are similar to those of *M. Russeliana* and *M. Pringlei* but they vary in length from 1–2 mm. In the remainder of the species the teeth are generally about 1 mm. long but occasionally may be as long as 2 mm. The orifice of the calyx may be glabrous, or hirsute with erect pili about 1 mm. long. When hirsute the pili may be sparse or very dense. This densely hirsute condition of the calyx is correlated with the pubescence on the upper lip of the corolla, for with the exception of *M. Pringlei* those species with densely hirsute calyces have a corolla with a comose upper lip.

Two principal corolla types can be perceived which differ in color, total length of the corolla, breadth of the throat, and the position of the stamens within the throat. In the first type, characterized by *M. didyma* and *M. Pringlei,* the corollas are bright red or vermilion, 35–45 mm. long, and are usually abruptly expanded upward to form a funnel-shaped throat, in which the stamens are seated at a depth of 3–8 mm. In the second type, characterized by the remainder of the species (with the exception of *M. Bartlettii*), the corollas range from white or pallid, but sometimes spotted with rose purple, to lavender or rose-purple, are 14–35 mm. long, and the tube is gradually expanded upward, the stamens being seated 1–3 mm. within the throat. *M. Bartlettii* seems to be intermediate between these two types. It has a corolla as long as those of *M. didyma* and *M. Pringlei,* and the throat is equally expanded, not abruptly as in those species, and the stamens are seated 4 mm. within the throat. It appears from dried specimens to be intermediate in color also. The small-flowered forms of *M. didyma* are also exceptional, for in them the corollas are less than 35 mm. long, do not show the broadly funnel-shaped throat of the larger-flowered forms, and are therefore not different from the corollas of the second type. The length of the corolla tube of this subgenus is generally three-fourths to two-thirds the total length of the corolla. The only notable variation in this respect is seen in *M. Bradburiana,* in which the tube is usually one-half the total length of the corolla. The expanded portion of the tube, the throat, is usually as long as or longer than the cylindrical unexpanded part. The external pubescence of the corolla varies, particularly on the upper lip. The entire corolla may be pubescent or occasionally nearly or quite glabrous, or the corolla tube may be pubescent and the upper lip comose.

Interspecific variation.—Within the section four species groups can be perceived. Each group is set apart by an aggregation of characters which may be floral or vegetative or a combination of both. These species groups are not clearly delimited, however, because of an overlapping of characters between species of different groups. They are as follows:

Group A: *M. didyma* and *M. Pringlei*
Group B: *M. Russeliana* and *M. Bradburiana*
Group C: *M. fistulosa, M. menthaefolia, M. Lindheimeri* (and *M. Bartlettii*)
Group D: *M. media* and *M. clinopodia*

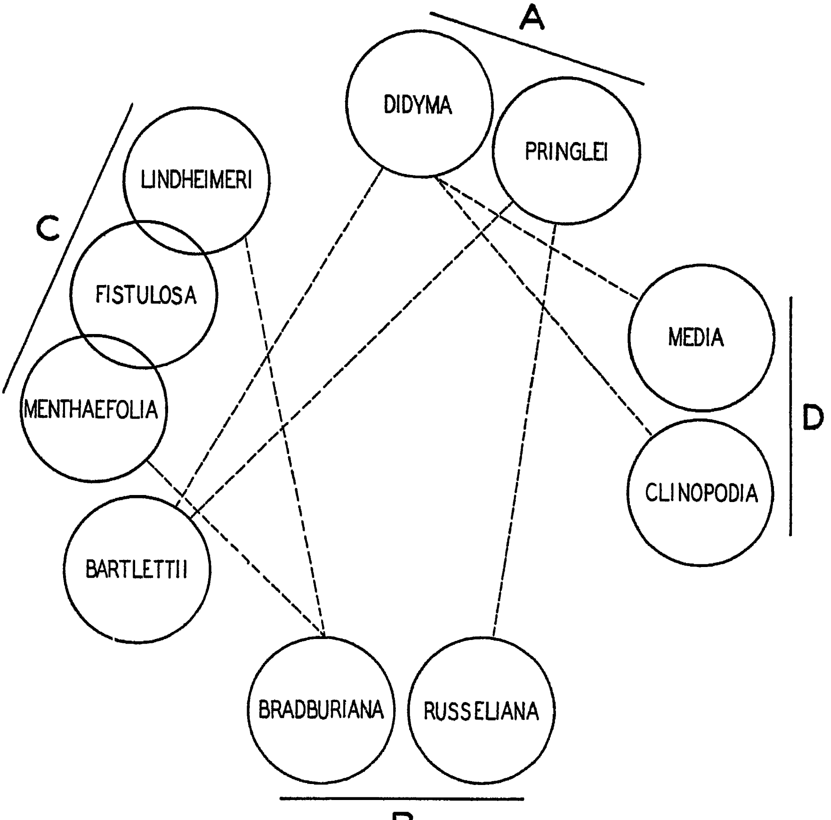

Fig. 2. Interrelationship of the species of section *Eumonarda.*

This arrangement is shown in figure 2. The overlapping circles of *M. fistulosa, M. menthaefolia,* and *M. Lindheimeri* are meant to suggest that these three species form the most closely related complex within the section. Although each of these species may be distinguished from the others by an accumulation of characters, there is a continuous pattern of variation between them in both floral and vegetative characters. *M. Bartlettii,* while resembling these species, is apparently a more distinct entity than any of them, but suggests *M. Pringlei* or *M. didyma* in corolla structure. However, its range of variation is unknown. The species of the other groups are shown as separate circles suggesting that speciation has proceeded further.

The lines between the groups suggest interrelationships as judged by the possession of characters in common. *M. Bradburiana, M. menthaefolia,* and *M. Lindheimeri* are similar in respect to vegetative characters, as are *M. didyma, M. clinopodia,* and *M. media; M. Bartlettii, M. didyma,* and *M. Pringlei* are similar in respect to length of the corolla, and *M. Russeliana* and *M. Pringlei* are similar in respect to calyx teeth and in vegetative characters.

SPECIES GROUP A

The relationship of *M. Pringlei* to *M. didyma* is shown particularly by the flower, for the similarity in color, proportions, and size of the corolla is striking. The corollas of both species are glabrous or puberulent and in this respect they are similar to *M. clinopodia* and *M. media* (Group D). The stamens are seated 3–6 mm. within the throat in *M. didyma,* and 8 mm. in *M. Pringlei.* The length of the calyces is about the same but the teeth differ in each. The teeth of *M. Pringlei* show closest resemblance to those of *M. Russeliana* (Group B) in size, shape and the presence of stalked glands. The teeth of *M. didyma* are shorter, varying from 1–2 mm. and are minutely puberulent but not glandular. The orifice of the calyx is naked or sparingly hirsute in *M. didyma,* as in Group D, but densely hirsute in *M. Pringlei,* as in Group C. *M. Pringlei* is the only species in which the upper lip of the corolla is glabrous and the orifice of the calyx densely hirsute (except *M. Russeliana* from Kentucky).

In vegetative characters the two species differ materially. *M. Pringlei* has simple stems, while the stems of *M. didyma* may be either branched or simple. The median leaves of *M. didyma* may be ovate or deltoid-ovate and are rarely as narrow as 3 cm., while those of *M. Pringlei* are lanceolate and not wider than 2.5 cm. The length of the petioles differs in each. In *M. Pringlei* they are less than 1 cm. long, and in *M. didyma* they range from 1–4 cm. in length. In habit of the stem, shape of the leaves, length of the petioles, and pubescence on the stem and leaves *M. didyma* resembles *M. clinopodia* and *M. media* (Group D), while *M. Pringlei* approaches the unbranched narrow-leaved forms of *M. Russeliana* (Group B). It should be pointed out, however, that the extent of variation of *M. Pringlei* is not clearly known.

SPECIES GROUP B

The relationship of the species in Group A is seen particularly in the floral habit. In Group B, however, although the flowers are sharply discontinuous in form, *M. Russeliana* approaches *M. Bradburiana* in vegetative habit to such a degree as to be readily confused upon casual examination of some specimens. *M. Bradburiana* is a remarkably stable species, showing unusual uniformity in habit of stem, leaf shape, length of the petioles, and the pubescence of the stems and leaves. The principal variation appears to be in the absolute sizes. The stem is simple, the median leaves ovate and the petioles are so short that the leaves appear to be sessile and even clasping the stem. *M. Russeliana* on the other hand varies in habit to a much greater degree than does *M. Bradburiana.* The occurrence of simple or branched stems is about equal, and the stems are sometimes lax rather than erect. In width and proportion of leaves the species shows a remarkable range. The largest leaves vary from twice as long as broad (strongly suggesting *M. Bradburiana,* as shown by *Demaree* 12749) to five times as long as broad (as shown by *Butler* 31). However, this variation does not appear to be correlated with geographic distribution, inasmuch as the extremes within a given collection may approximate those mentioned above, as for example the collections made by Demaree at Talihina, Oklahoma, and those made by Houghton at Idabel, Oklahoma.

M. Russeliana can always be distinguished from *M. Bradburiana* by the nature of the pubescence, which is retrorse or curled downward along the stems rather than spreading as in *M. Bradburiana.* Second, the tip of the galea is glabrous or hirtellous in *M. Russeliana,* while in *M. Bradburiana* it is comose with longer hairs. The proportions of the corolla are also significantly different. The upper lip of the corolla of *M. Bradburiana* is approximately equal to the tube, ranging from about 12–16 mm. in length, the throat is gradually narrowed and the stamens are seated about 2 mm. within the throat and are exserted approximately 2–3 mm. beyond the upper lip. The upper lip of the corolla of *M. Russeliana* is actually and proportionately shorter, ranging from about 10–13 mm. in length and about one-fourth as long as the tube, which ranges from 11–25 mm. in length. It appears to be more arcuate than the other species, thus resembling the corollas of *Cheilyctis.* The throat is rather abruptly narrowed and the stamens are seated about 1 mm. within the tube and are exserted approximately 5–6 mm. beyond the upper lip. The calyx teeth also afford another point of difference. In *M. Russeliana* they are 2 mm. long and beset with stout, capitate glands and in *M. Bradburiana* they are longer, about 3–4 mm., and the glands, when present, are smaller.

SPECIES GROUP C

The differences between *M. fistulosa* and *M. menthaefolia* seem at first acquaintance so slight that they might be considered as one species. However, the summation of habit of the two forms is distinctive to such a degree that upon further acquaintance each can be readily recognized. The length of the petioles is the most tangible difference. The median petioles of *M. menthaefolia* are rarely over 8 mm., while those of *M. fistulosa* are usually 10–15 mm., occasionally longer or rarely as short as 4 mm. *M. fistulosa* is usually branched and *M. menthaefolia* usually simple, although each varies occasionally to the other type. In height, the stem of *M. fistulosa* varies from 35–120 cm., a considerably greater range than that shown by *M. menthaefolia,* in which the usual range is from 30–75 cm. with only an occasional plant as tall as 100 cm. The shape of the leaves in both species is prevailingly ovate-lanceolate, although *M. menthaefolia* tends to be more ovate or oblong-ovate in the center of its range, while *M. fistulosa* tends to be broadly ovate-lanceolate. The length of the calyces ranges from 7–12 mm. for both species, but the means for each differ. *M. menthaefolia* has a mean calyx length of 9 mm. In the small-flowered eastern form of *M. fistulosa* the mean is 8 mm., and in the larger-flowered middle-western and southern form it is 10 mm. The calyx teeth are 1 mm. long and the orifice of the calyx is densely hirsute in both species. *M. fistulosa* shows a materially greater range in corolla length than does *M. menthaefolia*. *M. fistulosa* ranges from 19–35 mm., and *M. menthaefolia* ranges from 26–36 mm. The greater range in corolla length in *M. fistulosa* shows a correlation with the geographic distribution of the species. Plants which grow in the southwestern part of the range have corollas which are usually 29–30 mm., and those which grow to the north and east usually have corollas 23–28 mm. long.

The variation in stem pubescence follows the same pattern in both species, and in *M. Lindheimeri* as well. The prevailing type in all parts of the range of each of these species is formed of short, downwardly curled hairs. (This form in *M. fistulosa* has been known as *M. mollis*). The hairs of this type vary considerably in density. Some plants are densely pubescent, others sparsely so, while essentially glabrous forms may occur in which the pubescence is sparse and found only in the uppermost internodes or may sometimes be entirely wanting. The second type of pubescence consists of longer spreading pili and is less frequently found. In *M. fistulosa* this pilose form (nomenclatorially typical) reaches its fullest expression in the Appalachian Mountains, in Virginia, West Virginia, North Carolina, Tennessee, and Ohio, and is less frequently found in Connecticut, New York, New Jersey, and Pennsylvania. The pilose form of *M. menthaefolia* (*M. comata*) is much more restricted geographically, being known typically only from a few collections in southern Colorado and adjacent New Mexico, and a single specimen from Fort Rupert on Vancouver Island in British Columbia. In both *M. fistulosa* and *M. menthaefolia* combinations of these two pubescence types occur generally throughout their ranges. However, in *M. menthaefolia,* such combined forms are much less frequent in occurrence than in the former, where they are nearly as common as the short curled type. The pilose form of *M. Lindheimeri* (*M. hirsutissima*) is known from two collections from Louisiana. Two collections from Brazos County, Texas, have both types combined.

The geographic ranges of *M. fistulosa* and *M. menthaefolia* differ. *M. fistulosa* is much more widespread; it occurs in or east of the Plains States and the Canadian prairies. *M. menthaefolia* occurs in the Rocky Mountain region from British Columbia and Alberta southward to New Mexico and adjacent Texas. The region in which these two species overlap, namely in Montana, Wyoming, and North and South Dakota, show a number of variable and intermediate forms. Forms otherwise like *M. menthaefolia* frequently have branched stems and corollas less than the usual length. Forms similar to *M. fistulosa* in other respects may have petioles less than 1 cm. long. That these intermediates grow together in the same region is shown by the specimens collected by Lunell in the Turtle Mountains of Bottineau and Rolette counties in North Dakota. Occasionally what would appear to be typical forms of both species may be collected at the same place, as shown by Umbach's collection of August 20, 1901, from Belton, Montana, and Nelson's collection (no. 508) from Hartville, Wyoming, in both of which one sheet appears to be *M. fistulosa* and the other *M. menthaefolia.*

M. Lindheimeri resembles *M. menthaefolia* more closely than it does *M. fistulosa* because of the prevailingly short petioles and ovate leaves. It can be distinguished from *M. menthaefolia* by the more lax and widely branched glomerules, particularly noticeable in older specimens, and the pallid corollas which tend to be shorter, ranging from 17–30 mm. in length. There is also a tendency toward longer calyces and calyx teeth. These species are nowhere contiguous. *M. Lindheimeri* occurs only in southeastern Texas and central Louisiana, and although *M. menthaefolia* occurs in Texas, it is confined to the extreme western portion immediately south of New Mexico.

The differences between *M. Lindheimeri* and *M. fistulosa* are of a different sort from those between *M. Lindheimeri* and *M. menthaefolia*. *M. Lindheimeri* usually can be distinguished from *M. fistulosa* by the shorter petioles, the more ovate leaves, the pallid corollas and the loosely spreading glomerules. However, these differences are not always distinctive, since specimens are found which appear to be intermediate. Such specimens have ovate-lanceolate leaves, short petioles and small, compact glomerules and are uncertainly referable to either species. The geographic range of *M. fistulosa* in Texas is continuous with the range of *M. Lindheimeri,* which may account for the intermediate forms.

M. Bartlettii does not closely resemble any of the species in this group but rather seems to possess certain characters of this group and also of Group A. It approaches *M. fistulosa* in its branched habit and ovate-lanceolate leaves but it has shorter petioles. The length of the corollas is greater, and they are wider at the throat than those of the other species in the group, more like those of *M. didyma,* but they are similar in being gradually expanded upward. The corolla is magenta and is pubescent. The calyces and calyx teeth are both noticeably longer than in the other three species. The stems are pilose with long, slender hairs which spread tortuously rather than strictly as in the pilose forms of *M. fistulosa, M. menthaefolia,* and *M. Lindheimeri.* In texture, however, this pubescence is most like that of *M. Lindheimeri.* The leaves are pilose on both surfaces but more densely so on the lower, which sometimes appears canescent. So far as known the pubescence is not variable. The most distinctive characters of *M. Bartlettii* are the length and color of the corolla, the length of the calyces, the shape of the calyx teeth and the weakly spreading pili on the stem.

While it is true that the extremes of these proposed species overlap, the modes of each are sufficiently different to permit recognition. At the same time each mode is geographically separated. Each species can be recognized not by one or two distinctive characters but by combinations of several characters. The occurrence of the same pubescence types in the three species would seem to be a parallel development in each, and the resultant forms in each species do not seem sufficiently different to warrant considering them as separate species. Nor does it seem advisable to consider as one species each of the corresponding pubescence types in the three species recognized here, since such a segregation would imply recognition of only one difference rather than the accumulation of differences which actually exist. Of the four species in this group *M. Bartlettii* is the most distinct entity and the most easily recognized; *M. Lindheimeri* seems the least distinct and more or less intermediate between *M. fistulosa* and *M. menthaefolia.* However, until more is learned of the nature of variation of each species and because of the existence of established names for each, it has seemed more practicable to consider them as four species rather than as subspecies of one complex form, although they may prove to be the latter.

SPECIES GROUP D

The chief differences between *M. clinopodia* and *M. media* lie in the color of the corollas and outer floral bracts, and the somewhat larger corollas of *M. media. M. clinopodia* has white corollas and greenish bracts, while *M. media* has rose-purple corollas and bracts tinted the same color as the corollas. Nevertheless, there is a characteristic aspect to each, difficult to describe, but such that they may usually be recognized. The corolla length of *M. clinopodia* is seemingly bimodal. The mean of the smaller of these is 19 mm.; that of the larger is 25 mm. The total range in corolla size in *M. media* is 18–34 mm., a range as great as that of *M. clinopodia.* But because of the scant material of *M. media* which is available, it cannot with certainty be said that a similar bimodal condition exists in this species.

In habit, leaf shape, length of the petioles, and stem and leaf pubescence both species are similar to *M. didyma* (Group A). However, in length and proportions of the corolla, and the length of the calyces and the calyx teeth the species most closely resemble those of Group C (excluding *M. Bartlettii*). In both species, as in *M. didyma,* the corollas are glabrous or hirtellous and the orifice of the calyx is sparingly hirsute.

The intricate morphological interrelationships which exist between such diverse groups as the small white-flowered *M. clinopodia* and the large vermilion-flowered *M. didyma* suggest strongly that they may be connected by a series of polyploids. Indeed, with the possible exception of *M. Bradburiana* and *M. Russeliana,* which are set somewhat apart, it would appear that the whole subgenus is a polyploid complex. The taxonomic arrangement which is employed here is therefore only of the most tentative sort and can be considered as no more than suggestive of the points of attack which may be made upon this complex group. Until a more definitive treatment is possible, it has seemed preferable to retain as simple a nomenclature as possible.

KEY TO THE SPECIES

A. Corollas 4–8 mm. broad at the upper expanded portion of the throat (rarely 3 mm. in *M. didyma*), 30–45 mm. long, vermilion or magenta; stamens seated 4–6 mm. within the throat (rarely 3 mm. in *M. didyma*).

B. Corolla tube gradually expanded upward with no apparent division between the lower cylindrical portion and the upper expanded portion (throat); corolla magenta, pubescent, the upper lip comose; plants of northeastern Mexico.

5. M. Bartlettii

BB. Corolla abruptly expanded in the upper half, an apparent division between the lower cylindrical portion and the expanded upper portion (throat) being readily observed (except in the smaller-flowered forms of *M. didyma*); corolla vermilion, nearly or quite glabrous, the upper lip sometimes hirtellous but not comose.

C. Leaves lanceolate, not over 2–5 cm. broad; plants of northeastern

CC. Leaves ovate to ovate-lanceolate, not less than 3 cm. broad; plants of the eastern United States .... 1. **M. didyma**

AA. Corollas 1–3 mm. broad at the expanded upper portion of the throat, rarely more, 14–33 mm. long (occasionally 35–36 mm. long in *M. fistulosa* and *M. menthaefolia*); white, lavender or rose-purple; stamens seated 1–2 mm. within the throat (rarely 3 mm. in *M. menthaefolia*).

B. Petioles not more than 8 mm. long (rarely 11 or 12 mm. in *M. menthaefolia*); stem usually simple (those of *M. Russeliana* and *M. Lindheimeri* occasionally branched).

C. Calyx teeth 2–4 mm. long, acicular, tending to curve; upper lip of corolla approximately one-half as long as the corolla; a species infrequently found in Arkansas and Oklahoma, ranging chiefly from Missouri eastward in the valley of the Ohio River .... **M. Bradburiana**

CC. Calyx teeth 1–2 mm. long, erect, subulate; upper lip of corolla about one-third as long as the corolla.

D. Corolla and upper lip glabrous or hirtellous; calyx teeth 2 mm. long, bearing stalked, capitate glands; a species confined to Arkansas, Oklahoma and adjacent Texas, and Powell and Bath counties, Kentucky. **M. Russeliana**

DD. Corolla pubescent, upper lip comose; calyx teeth usually 1 mm. long (may be 1–2 mm. in *M. Lindheimeri*) but not bearing stalked, capitate glands; species found either in coastal Texas and Louisiana, or in the Rocky Mountains.

E. Glomerules 2–5 cm. broad, excluding the corollas, usually lax and open so that the component branches are visible, at least in older specimens, pedicels 1–3 mm. long; leaves commonly ovate; corolla apparently pallid; calyx teeth 1–2 mm. long; a species of southern Texas and central Louisiana .... 8. **M. Lindheimeri**

EE. Glomerules 1.5–2.5 cm. broad, compact, the component branches never visible; pedicels 1 mm. or rarely 2 mm. long; leaves commonly ovate-oblong or ovate-lanceolate; corollas rose color; calyx teeth 1 mm. long; a species of the Rocky Mountains ranging into Texas south of New Mexico .... 7. **M. menthaefolia**

BB. Petioles more than 1 cm. long, rarely less in *M. fistulosa;* stems usually branched in the upper parts.

C. Corollas pubescent, lilac or pink (rarely tending to rose-purple), comose on the upper lip; orifice of calyx densely hirsute with erect hairs; stems prevailingly pubescent with downwardly curled hairs, less often pilose with longer spreading pili in addition (or the longer pili sometimes found alone); leaves prevailingly ovate-lanceolate .... 6. **M. fistulosa**

CC. Corolla glabrous or, if pubescent, the upper lip not comose, dull white or rose-purple, tending to crimson; orifice of calyx glabrous or with a few scattered pili; leaves prevailingly ovate or deltoid-ovate; stems glabrous or bearing scattered spreading pili.

D. Corolla white or flesh-color, often with purple spots; outer bracts green or pallid, sometimes with a purple midvein .... 10. **M. clinopodia**

DD. Corolla rose-purple; outer bracts tinted with rose .... 9. **M. media**

1. **M. didyma** L.

M. didyma L., Sp. Pl. 1: 22, 1753; the standard may be taken as a specimen in the Linnean Herbarium which was annotated by Linneus; it was present at the first enumeration and is apparently a garden plant.

M. Kalmiana Pursh, Fl. Amer. Sept. 1: 17, 1814, based upon plants seen living near Onondago and Oswego; no specimens have been preserved at the Academy of Sciences of Philadelphia; the specimen in the Pursh Herbarium at Kew, which is probably the one illustrated, is the narrow-leaved form which is mentioned below; the Kalm plant of the Banksian Herbarium, which is referred to by Pursh, is also the narrow-leaved form.

? *M. purpurea* Pursh, Fl. Amer. Sept. 1: 17, 1814, based upon specimens seen in the mountains of Virginia; a specimen in the Lambert Herbarium is also referred to; apparently none are preserved; the plant may have been *M. media* or *M. fistulosa* var. *rubra* or a hybrid.

M. coccinea Michx., Fl. Bor. Amer. 1: 16, 1803; a specimen is preserved in the Michaux Herbarium at Paris.

M. oswegoensis Bart., Prodr. Fl. Philad. 1: 34, 1815; no specimen is preserved in the Bartram Herbarium at the Academy of Natural Sciences at Philadelphia.

Perennial herbs commonly 70–120 cm. tall, their stems simple or branched from the middle, glabrous or thinly pilose with scattered slender hairs; largest leaves usually two to three times as long as the internodes which they subtend, less frequently equal to them, ovate to deltoid-ovate or ovate-lanceolate, the largest usually borne at the third to the fifth node below the glomerule, rarely lower, 6–14 cm. long, 3–8.5 cm. broad, the widest part of the leaf 1–5 cm. above the base, usually about 2–3 cm.; all leaves serrate, thinly hirsute with slender appressed hairs above, more densely so beneath, especially along the veins; median petioles 1–4 cm. long, usually 1.5–2 cm., hirsute with long slender spreading hairs; glomerules 2–4 cm. broad excluding the corollas, the outer bracts subfoliar, tending to be membranous, red tinted, spreading or reflexed; calyces 9–14 mm. long, usually crimson, glabrous or puberulent with minute spreading hairs, the teeth 1–2 mm. long, the orifice subglabrous; corolla bright crimson, 30–45 mm. long, the tube 20–30 mm. long, commonly two-thirds to three-fourths as long as the entire corolla, usually slightly more than twice the length of the calyx, the upper lip hirtellous or glabrous, not bearded, the stamens seated 2–4 mm. within the tube, exceeding the galea by about the same distance.

M. didyma is relatively stable. The stems may be either branched or simple; both forms are of equal occurrence. The pubescence varies in degree but not in kind. The greatest variation is found in the size and shape of the leaves. Plants occur with leaves which show a range from 3.5–8.5 cm. in breadth (mean of 5.2 cm.), and 6–13.5 cm. in length (mean of 9.2 cm.). These are frequently cordate at the base. Other plants occur with narrower leaves, which show a range from 3–5.5 cm. in breadth (mean of 4.4 cm.), and 8–14.5 cm. in length (mean of 11.8 cm.). Extreme leaves for each of these forms are shown in figure 3. Both forms are found in New York and Pennsylvania, and sparingly in the New England states, Maryland, New Jersey, Michigan, and Ohio. It would appear, however, that only the narrow-leaved form is found in Virginia, West Virginia, North Carolina, and Tennessee, as is shown in figure 4 (p. 160).

The corollas of *M. didyma* show a range in length from 30–45 mm., the greatest variation in corolla length found within the section. This variation is correlated to some degree with the variation in leaf shape. When corollas of the broad- and narrow-leaved forms are considered separately a difference is seen in the means of the two forms. The broad-leaved form has a mean corolla length of 35 mm. and the narrow-leaved form a mean of 39 mm.

The smaller corollas, particularly those less than 35 mm. long, show a less abrupt and apparent broadening of the corolla tube upward. These corollas, therefore, resemble the gradually expanded corollas of Groups B, C, and D. However, no difficulty is found in identifying these forms since their corollas are bright red and are longer than the corollas of the species in the other groups which occur in the same region.

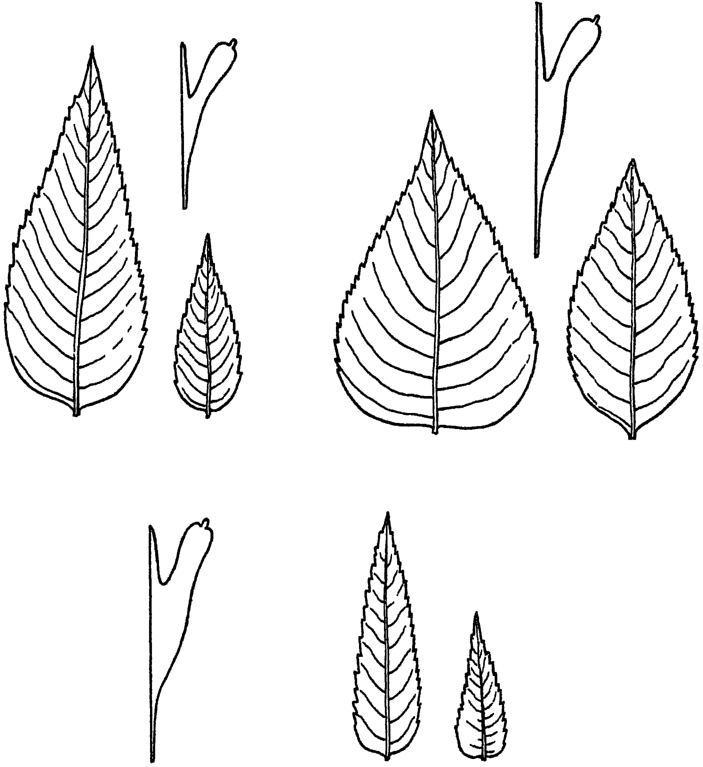

Fig. 3. Approximate diagrammatic range in variation of leaf size and form of *M. didyma* and *M. Pringlei*. The upper figures on the left refer to the narrow-leaved form of *M. didyma*, those on the right to the broad-leaved form. The corollas illustrate the mean size for each form. The lower figures illustrate the same for *M. Pringlei* and provide a comparison of the two species. The drawings in this and the following similar figures were made from measurements of dried, and, in the corollas, boiled specimens. The shape of the leaf was obtained by tracing of the largest median leaf. The absolute dimensions will be found in the text.

Distribution (see fig. 4).—Many of the localities, particularly in the northern part of the range, doubtless represent escapes and introductions.

CANADA. Ontario. Lambton County, Quebec.

UNITED STATES. Connecticut. Fairfield, Hartford, Litchfield, New Haven, Tolland (*Weatherby* 4706) counties. Maine. Oxford County. Maryland. Garrett (*Steele* 60) County. Massachusetts. Berkshire County. Michigan. Saint Clair, Washtenaw counties. North Carolina. Avery (*Wiegand and Manning* 2737), Buncombe (*Biltmore Herb.* 4218, *Standley and Bollman* 9991), Haywood (*Oosting* 34679), Jackson, Macon, Mitchell (*Cannon* 103, *Rydberg* 9337, *Heller* 144), Swain, Transylvania (*House* 4388), Watauga counties. New Hampshire. Coos County. New Jersey. Hunterdon, Sussex, Warren counties. New York. Cattaraugus (*Alexander and House* 12076), Chautauqua, Chemung (*Lucy* 272; 8584), Chenango, Cortland, Delaware, Greene, Herkimer, Lewis, Livingston, Madison, Nassau, Oneida, Onondago, Oswego, Rockland, Steuben, Suffolk (*Ferguson* 4412, *St John* 2890), Sullivan, Tompkins, Tioga (*MacDaniels* 4896), Warren counties OHIO Franklin, Medina, Montgomery, Portage counties PENNSYLVANIA Allegheny, Blair, Bradford, Bucks, Butler, Cameron, Clarion, Delaware, Erie, Fayette, Franklin, Lebanon, Luzerne, Lycoming, Monroe,

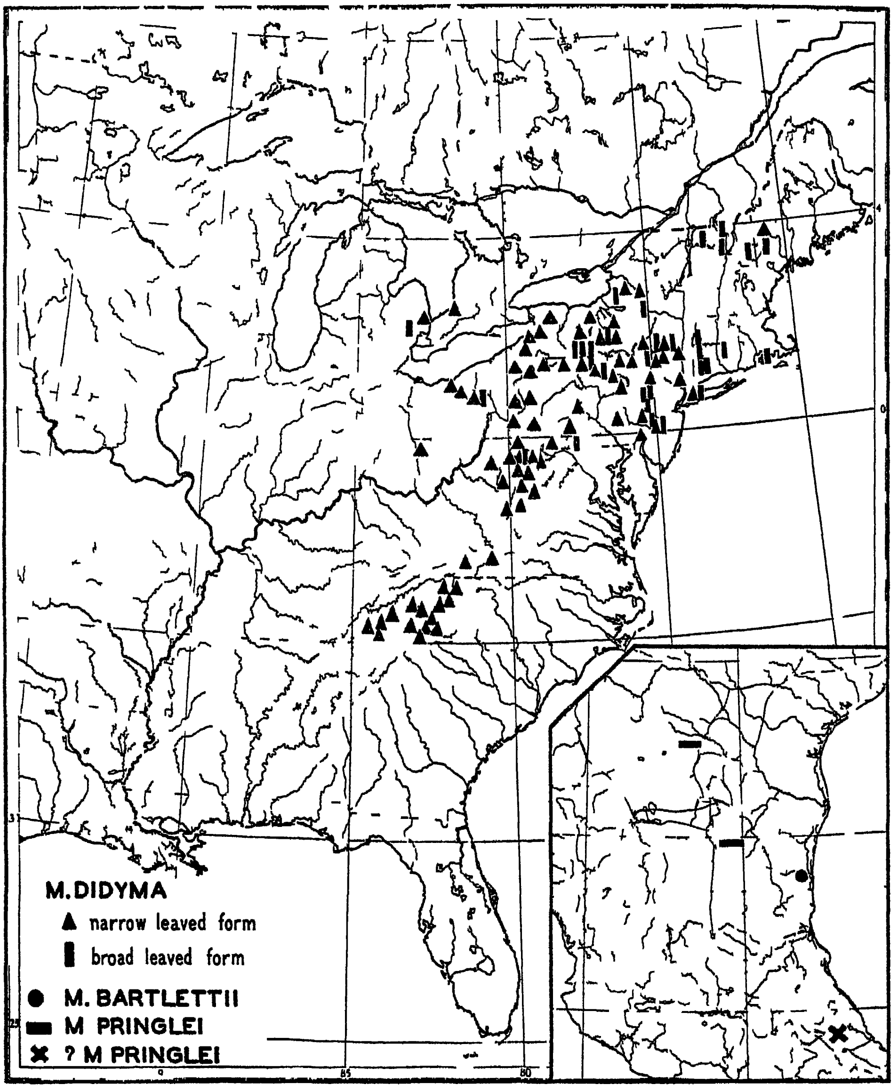

Fig 4 Distribution of *M didyma, M Pringlei*, and *M Bartlettii* The plants in Vera Cruz which are questionably referred to *M Pringlei* may be specifically or subspecifically distinct.

Northampton, Pike, Potter, Somerset, Sullivan, Susquehanna (*Pennell* 10835), Tioga, Warren, Westmoreland counties TENNESSEE Blount (*Camp* 1724, *Jennison* 31558), Carter, Claibourne (*Ruth* 51), Cocke (*Kearney* 865), Sevier (*Wehmeyer* 347) counties VERMONT Addison, Caledonia, Franklin counties VIRGINIA Highland (*Wherry and Pennell* 13387), Montgomery (*Rydberg* 9303), Smyth counties WEST VIRGINIA Grant, Hancock, Harrison, Mineral, Monongalia, Pendleton, Pocahontas, Preston, Randolph (*Millspaugh* 486, *Greenman* 474, 482) counties

2. M. Pringlei Fern.

M. Pringlei Fern., Proc. Amer. Acad. 36: 501, 1901; type collected by C. G. Pringle (no. 2199) near Monterrey, Mexico (Gray Herb.).

M. Eplingiana Standley, Field Mus. Publ. Bot. 17: 208, 1937; type collected by E. G. Marsh (no. 604) in the Sierra del Carmen, Coahuila, Mexico (Field Mus.).

Perennial herbs 50–100 cm. tall, their stems simple, glabrous; largest leaves deltoid-lanceolate, 5–8.5 cm. long, 1.8–2.2 cm. broad, broadest 5–10 mm. above the base, usually about 1–1.5 times as long as the internodes which they subtend, borne at the third or fourth node below the glomerule; all leaves serrate, glabrous on both surfaces; median petioles 3–8 mm. long, glomerules 22–27 mm. broad, excluding the corollas; outer bracts subfoliar, spreading, red tinted; calyces 11–12 mm. long, glabrous, the orifice hirsute with erect hairs, the teeth 2 mm. long, bearing stalked glands; corollas crimson, 40–42 mm. long, pubescent with short curled hairs, the upper lip pubescent but not comose, the tube 27–30 mm. long, expanded somewhat abruptly upward; stamens seated 6 mm. within the tube.

Distribution (see fig. 4).—MEXICO. NUEVO LEON. Calcareous slopes, Sierra Madre above Monterrey, 3000 ft. (*Pringle* 10187; 15614), near Monterrey (*Pringle* 2199). COAHUILA. Sierra del Carmen (*E. G. Marsh* 604; 818), Sierra del Carmen, Canon de Sentenela on Hacienda Piedra Blanca (*Wynd and Mueller* 627).

Not included in this distribution are several specimens collected in Vera Cruz. They differ from Pringle's specimens in the shape of the leaves, the length of the calyx teeth, and the length and shape of the corollas. The leaves are shorter and more ovate than the Monterrey specimens. The calyces are approximately the same length as the Monterrey specimens, but the calyx teeth are not so conspicuously glandular. The corollas of the Vera Cruz specimens are shorter, ranging from 24–33 mm., and are gradually narrowed upward; the stamens are seated 1–2 mm. within the throat. The several specimens which have been collected are all inadequate and it is difficult to form an opinion of them. They are as follows: VERA CRUZ. Noalinco (*Purpus* 6048), Jalapa (July 1932, *O. A. Plunkett*), Las Virgens (1841–1843, *Leibmann* 15583).

3. M. Bradburiana Beck

M. Bradburiana Beck, Amer. Jour. Sci. and Arts 10: 260, 1826; type collected in the barrens north of St. Louis, Mo., by Beck (Herb. of the New York State Museum).

M. rigida Rafin., Mod. Fl. 2: 37, 1830, based upon specimens seen in Kentucky; no authentic specimens are extant, so far as known.

M. villosa Martens, Bull. Acad. Roy. Sci. 66, 1841; type collected near St. Louis by Pere Ducrinck (Natl. Herb. Brussels).

Perennial herbs commonly 30–50 cm. tall, their stems simple, rarely if ever branched, the median internodes usually equal to or shorter than the blades, entirely glabrous or sprinkled with slender spreading hairs; lower leaf blades commonly ovate, the median ones narrowly deltoid-ovate, the largest borne commonly at the second or third node beneath the glomerule, 4–10 cm. long, 2–5.5 cm. broad, commonly about 3.5 cm., the broadest part being usually about 1.5 cm. above the base, all leaves serrulate or the upper pair subentire, thinly hirsute on both surfaces with slender appressed hairs or glabrous on the upper surface, hirsute beneath only on the veins, essentially sessile, even clasping the stem, the median petioles rarely more than 3 mm. long; glomerules 2–3 cm. broad excluding the corollas, usually 2–2.5 cm., the outer bracts subfoliar, tending to membranous and often purplish tinted, spreading or reflexed; calyces 9–14 mm. long, commonly about 10–13 mm., teeth acicular, 2–4 mm. long, often bearing short capitate glands and usually a few longer pili, the orifice hirsute, the tube puberulent with minute spreading hairs and sometimes with longer pili near the middle; corolla pale or white, purple dotted, 24–38 mm. long, the tube 12–19 mm. long, the upper lip bearded, the throat hirtellous within.

This species is remarkably stable, and is fairly uniform in habit of stem, leaf, and pubescence (fig. 5). The principal variation appears to be in the absolute sizes of these. The upper lip of the corolla is approximately the same in length as the tube, or but little shorter. In this respect *M. Bradburiana* is unlike the other species of this section.

Distribution (see fig. 6).—ALABAMA. Blount, Cullman, Jefferson, St. Clair counties. ARKANSAS. Benton, Carroll (*E. J. Palmer* 4462; 5549), Fulton (*Pennell* 11560), Garland (*Demaree* 14869), Perry, Van Buren, Washington (*E. J. Palmer* 27003) counties. ILLINOIS. Cook, Gallatin (*E. J. Palmer* 15278), Jackson, Marion, Pulaski (*E. J. Palmer* 15104), Richland, St. Clair, Schuyler, Union (*Earle* 719), Washington counties. INDIANA. Knox (*Deam* 11034), Posey (*Deam* 974) counties. KANSAS. Cherokee County. KENTUCKY. Hopkins (*E. J. Palmer* 17691), Lyon (*Eggleston* 4673), Union counties. MISSOURI. Barry (*Bush* 120), Benton, Cape Girardeau, Carter, Christian (*Pennell* 11644), Cole (*Steyermark* 24919), Dallas, Franklin, Greene (*McKelvey* 2520, *Standley* 8542), Jasper, Jefferson (*Greenman* 4229), Lawrence, Lincoln, Madison, Maries, Marion, Moniteau (*Steyermark* 24776), Morgan, Pettis (*Steyermark* 21399), Pike (*Steyermark* 25883), Polk, Reynolds (*Smith* 285), St. Charles, St. Francois, Ste. Genevieve, St. Louis (*Bartram* 1470; 3006, *Benke* 4297, *Pennell* 11698), Scott, Shannon (*Bush* 4769, *Steyermark* 1860), Stone (*E. J. Palmer* 5716), Taney, Texas, Warren, Webster, Wright (*Lansing* 2965) counties. NEBRASKA. Fort Pierre. OKLAHOMA. Le Flore County (*Goodman* 2486). TENNESSEE. Cheatham, Davidson, Wayne (*Weatherby* 6337) counties. TEXAS. Kerr County.

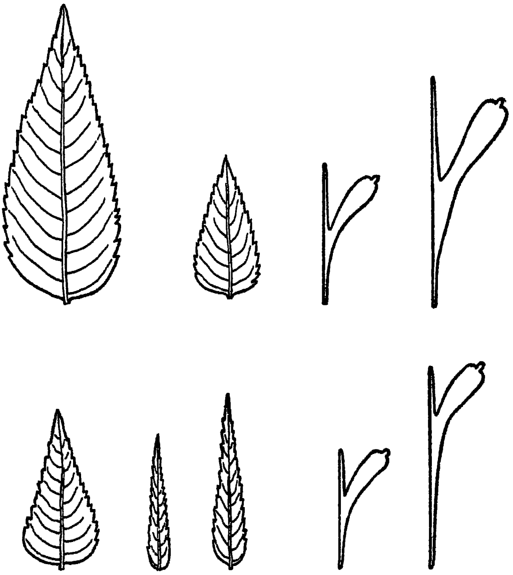

Fig. 5. Approximate diagrammatic range in variation of leaf size and shape and corolla size in *M. Bradburiana* (above) and *M. Russeliana* (below). Note differences in proportions of the corolla.

4. **M. Russeliana** Nutt.

M. Russeliana Nutt., Jour. Trav. Arkansas Terr. 141, 1821, name only; ex Sims, Bot. Mag. 51: t. 2513, 1824; Trans. Amer. Phil. Soc. V: 185, 1837, based upon a specimen collected near Fort Smith in Arkansas by Nuttall; the type or standard is in the British Museum of Natural History.

M. virgata Raf., Med. Fl. 2: 37, 1830, based upon a specimen collected in the "barrens, West Tennessee and Arkansas"; a specimen so named and collected by Rafinesque is in the Delessert Herbarium; the specimen is narrow-leaved.

Perennial herbs 30–60 cm. tall, their slender stems simple or sparingly branched from the middle, the median internodes commonly about twice the length of the subtending leaves, all correspondingly elongated and often tortuous as though growing through shrubbery, sprinkled with a few downward curling hairs or entirely glabrous, the hairs finer than in *M. Bradburiana*; lower leaf blades sometimes ovate, sometimes narrowly deltoid-lanceolate, the median similar, the largest being borne at the third or fourth node beneath the glomerule,

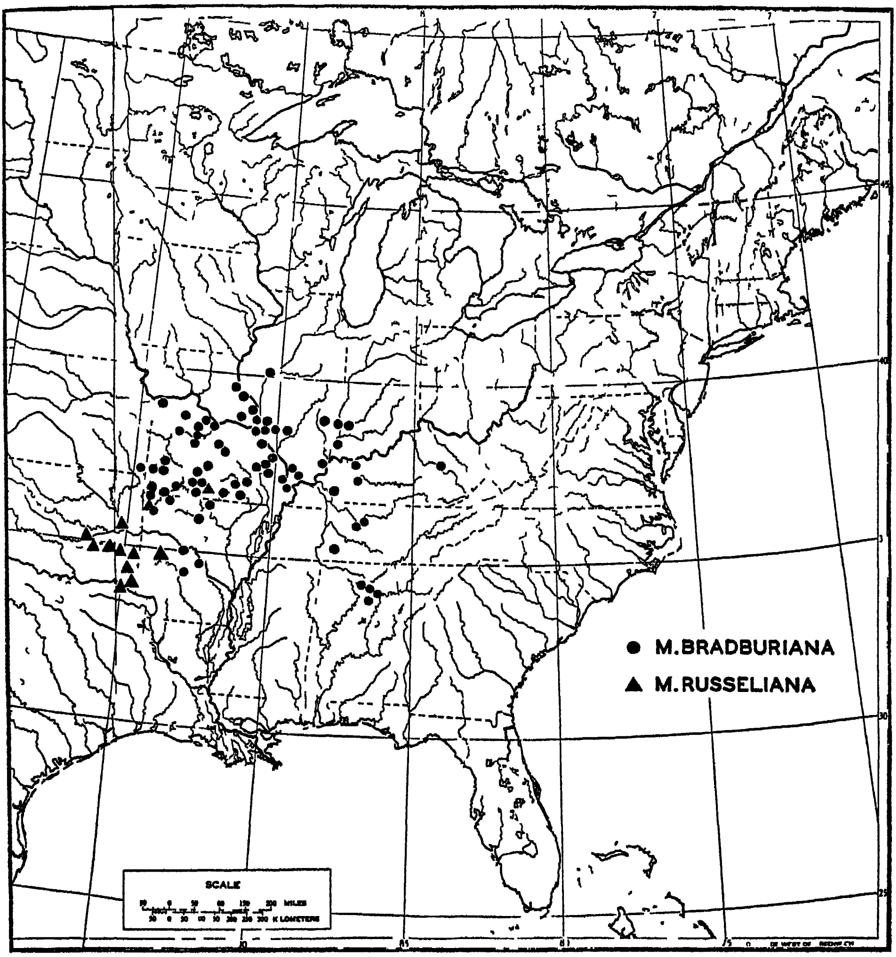

Fig. 6. Distribution of *M. Bradburiana* and *M. Russeliana* (except in Kentucky).

4–6 cm. long, 1–2.5 cm. broad, the broadest part being usually about 1 cm. above the base, all leaves remotely serrulate, the narrower-leaved forms and the uppermost tending to entire, thinly hirsute with upwardly directed hairs, especially along the margins, the hairs of the upper surfaces usually shorter or wanting, subsessile, the median petioles 2–5 mm. long; glomerules commonly about 2 cm. broad, excluding the corollas, the outer bracts subfoliar, tending to membranous and often purplish tinted, usually reflexed; calyces 8–12 mm. long, commonly 8–10 mm., the teeth subulate, usually about 2 mm. long, bearing stubby capitate glands, the orifice thinly hirsute, densely hirsute in Kentucky specimens, the tube puberulent with minute spreading hairs and sprinkled with longer hairs similar to those of the stems; corolla pale or white, purple dotted, 20–35 mm. long, the tube 11–25 mm. long, the galea hirtellous or glabrous, not bearded, the throat hirtellous within.

M. Russeliana varies chiefly in vegetative characters (fig. 5). As pointed out previously, the leaves vary in shape from narrowly lanceolate to deltoid-ovate, approaching those of *M. Bradburiana.*

Distribution (see fig. 6).—Arkansas. Garland (*E. J. Palmer* 24892), Polk (*Benke* 5507), Washington (*Harvey* 63, *E. J. Palmer* 23308) counties. Kentucky. Powell (*Wharton* 2411), Bath (*Wharton* 2578) counties. Oklahoma. Hughes (*Demaree* 12723), Le Flore (*Demaree* 12749, *E. J. Palmer* 37357, *Stevens* 1396), McCurtain (*Houghton* 3650; 3655, *Demaree* 12617), Muskogee (*Goodman* 2136), Pittsburgh (*Oyster s.n., Pennell* 10498) counties. Texas. Lamar County (*McMullen s.n.*).

5. **M. Bartlettii** Standley

M. Bartlettii Standley, Field Mus. Publ. Bot. 17: 208, 1937; type collected by H. H. Bartlett (no. 10094) in Mexico, La Vegonia, vicinity of San Jose, Tamaulipas, July 5, 1930 (Field Mus.).

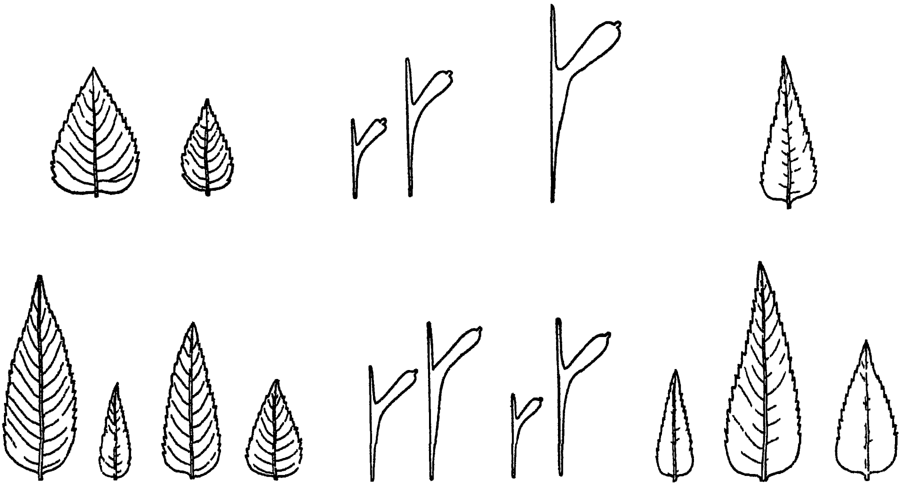

Fig. 7. Approximate diagrammatic range of variation in leaf size and form and corolla size and form in *M. Lindheimeri* (upper left), *M. Bartlettii* (upper right), *M. menthaefolia* (lower left), and *M. fistulosa* (lower right).

Perennial herbs about 75 cm. tall, their stems branched in the upper parts, densely hirsute with rather long, slender, somewhat spreading but tortuous, jointed hairs; largest leaves ovate-lanceolate, longer than the internodes which they subtend, borne at about the fifth node below the glomerule, 6 cm. long, 2.5 cm. wide, broadest about 1 cm. above the base; all leaves serrate, the upper surfaces thinly hirsute with slender hairs, the lower surfaces more densely so; median petioles mostly 5 mm. long, hirsute; glomerules 3 cm. broad, the outer bracts subfoliar, red tinted, spreading; calyces 12–16 mm. long, red tinted, minutely puberulent with spreading hairs and sprinkled sparsely with longer hairs, the teeth 1–2 mm. long, bearing stubby glands, the orifice hirsute with stiff erect hairs; corolla bright magenta, 42–45 mm. long, pubescent with slender curling hairs similar to those of the stems, the upper lip comose, the tube 28–30 mm. long, gradually expanded upward; stamens seated about 4 mm. within the tube.

This plant suggests *M. fistulosa* in habit, but is notably hairy. The flowers, however, are more nearly those of *M. Pringlei* (figs. 4, 7).

Distribution.—MEXICO. Tamaulipas. San Jose, near La Vegonia, 3200 ft. (July 1930, *H. H. Bartlett* 10094); Cerro Zamora, near El Milagro (August 1930, *Bartlett* 11051).

6. M. fistulosa L.

M. **fistulosa** L. Sp. Pl. 1: 22, 1753, based upon a garden specimen in the Linnean Herbarium present at the first enumeration (see Fernald, Rhod. 3: 14, 1901); it is a pilose plant as described by Robinson and like the plant of Hortus Cliffortianus, which should preferably be taken as the type or standard (see Epling, Jour. Bot. 1929, p. 3).

M. mollis L., Amoen, Acad. 3: 390, 1764; there is no specimen thus annotated by Linneus in the Linnean Herbarium; there is, however, a specimen of the form commonly known as *M. mollis* which was annotated "mollissima" by Linneus. Since the word "mollissima" occurs in the original description, it is not impossible that this is the plant which Linneus had in hand. It is apparently a garden plant, finely puberulent, with an occasional longer hair.

M. scabra Beck, Amer. Jour. Sci. 10: 260, 1826; type collected by Beck near St. Louis, Mo. (Herb. State Mus. New York).

? M. fistulosa var. *rubra* Gray, Syn. Fl. N. Amer. 2:374, 1878; type collected by Gray in the "Tennessee Mountains on the way to Roan" (Gray Herb.).

M. fistulosa var. *mollis* L., Sp. Pl., ed. 2, 2: 32, 1762.

Perennial herbs 35–120 cm. tall, their stems usually branched, less frequently simple, prevailingly pubescent in the upper parts with downwardly curled hairs and glabrous below, less often pilose with longer spreading hairs, these usually in addition to the short curled hairs, but sometimes appearing alone, rarely wholly glabrous; largest leaves prevailing ovate-lanceolate, tending to ovate or lanceolate, one to two times as long as the internodes which they subtend, borne at the third to the seventh node below the glomerule, 3.5–10 cm. long, 1–3.5 cm. broad, the broadest part .5–2 cm. above the base of the leaf; all leaves serrate, or less frequently subentire, their upper surfaces hirtellous with more or less appressed hairs, rarely hirsute with longer hairs and similar to the lower surfaces, the lower surfaces usually pubescent with curled hairs, sometimes canescent and subtomentose, or both leaf surfaces rarely wholly glabrous; median petioles mostly 8–15 mm. long, rarely as short as 4 mm. or as long as 27 mm., usually pubescent with short appressed hairs; glomerules 1.7–3 cm. broad, excluding the corollas; outer bracts subfoliar, frequently pink tinted, reflexed rather than spreading; calyces mostly 7–10 mm. long, occasionally as long as 12 mm., puberulent with short spreading hairs, the teeth usually 1 mm. long, occasionally 1.5–2 mm., acuminate, the orifice hirsute with stiff erect hairs within, sometimes bristling with similar spreading hairs at the base of the teeth; corolla lavender, 19–25 mm. long, prevailingly 23–30 mm., except for a race ranging from Missouri to Texas in which the corollas are commonly 27–30 mm., pubescent with short curling hairs, the upper lip comose, the tube prevailingly 15–18 mm. long, rarely as long as 24 mm., gradually expanded upward; stamens seated about 1 mm. within the tube.

The corollas and calyces of *M. fistulosa* show a marked variation which seems to be partly correlated with geographic distribution. The total range in corolla length is 19–35 mm. and the calyx range is 8–12 mm. The forms which grow in Texas, Oklahoma, Kansas, Arkansas, and Missouri have corollas which fall within the total range, but the usual range is 29–30 mm. The forms which occur to the north and east of these states have a corolla range of 19–30 mm., with a usual range of 23–28 mm. The large-flowered forms have notably larger calyces, ranging from 8–12 mm. with a mean of 10 mm., while in the smaller-flowered forms the calyces range from 6–10 mm. long with a mean of 8 mm. The calyx teeth in the large flowered form are frequently 1.5–2 mm., while in the smaller flowered form they are only 1 mm. long.

There seems to be a tendency for a narrow-leaved, unbranched, more slender form to occur in the southeastern states, particularly in North Carolina, Alabama, Tennessee, and Kentucky. In habit this form is like the narrow-leaved, more slender forms of *M. menthaefolia* which occur in Arizona and New Mexico (*M. stricta*).

The variation in pubescence is not correlated with any other character. The pilose form with spreading hairs is the nomenclatorial type of the species. It occurs only in a restricted part of the total geographic range, as shown in figure 8. The more widely disseminated form with short curled pubescence has been called *M. mollis*. Plants with mixed pubescence occur generally throughout the range of *M. mollis*, but so far as may be judged from the available material do not seem to be as abundant. While the extremes of each form are distinctive in pubescence, all combinations of both occur. This single difference does not seem sufficient to warrant specific recognition.

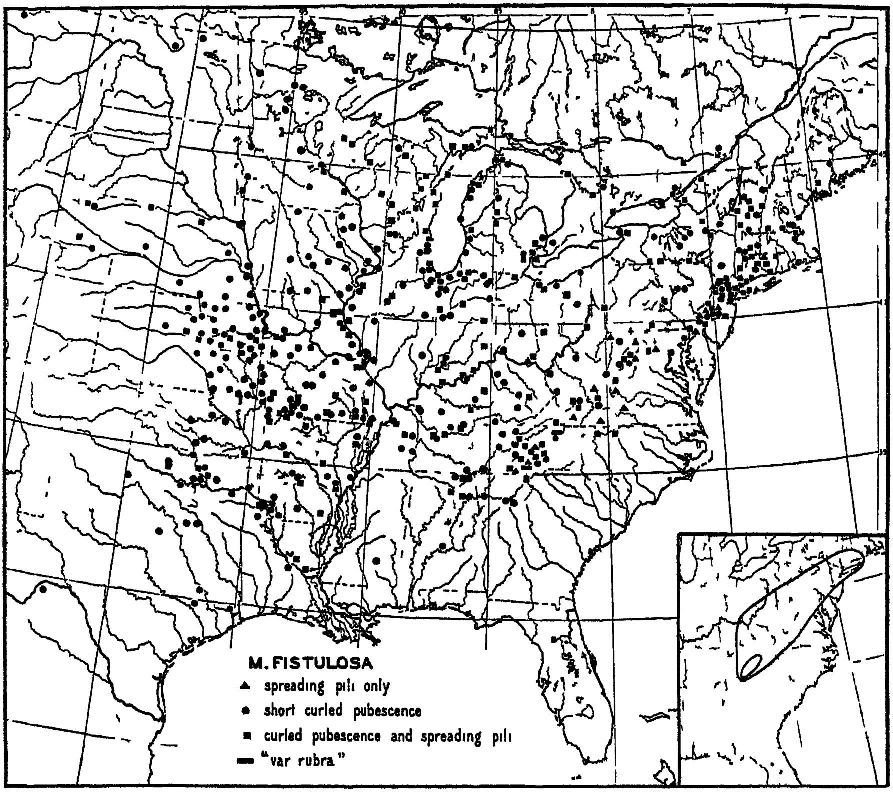
M. FISTULOSA
▲ spreading pili only
● short curled pubescence
■ curled pubescence and spreading pili
▬ "var rubra"

Fig. 8. Distribution of *M. fistulosa.* Insert outlines approximate limits of distribution of "var. *rubra.*" Small oval indicates its probable distribution in nature; the larger oval indicates its distribution apparently as an escape or as naturalized.

A form which has been referred to as *M. fistulosa* var. *rubra* occurs in the Appalachian Mountains. This form has rose-purple corollas and bracts, and the corollas range in size from 25–33 mm. The orifice of the calyx is bearded, the calyx teeth are 1 mm. long, and the upper lip of the corolla is comose as in *M. fistulosa,* but the stem pubescence and leaf shape are those of *M. didyma.* This suggests either a possible hybrid or an allopolyploid from these two species. The size and color of the flowers are more or less intermediate between the putative parent species.

Most of the scant material available for this form has either been cultivated or is a garden escape from the New England states, New York, or Pennsylvania. Only three sheets have been seen which could with certainty be considered to have been taken from the wild. These were from Roan Mountain, Tennessee, and from Balsam and Waynesville, North Carolina (fig. 8).

Distribution.—Specimens with spreading pili only (see fig. 8):

CONNECTICUT. Tolland County. MISSOURI. Barry County (*E. J. Palmer* 6298). NEW JERSEY. Lake County. NEW YORK. Cattaraugus, Suffolk counties. NORTH CAROLINA. Cherokee, Haywood counties. OHIO. Scioto County. PENNSYLVANIA. Susquehanna County. TENNESSEE. Cocke County. VIRGINIA. Campbell, Fairfax, Loudoun, Rockbridge, Shenandoah (*John K. Small,* July 1892), Smyth counties. WEST VIRGINIA. Clay, Greenbrier, Hampshire counties.

M. fistulosa var. *rubra:*

NORTH CAROLINA. Haywood County: Eagles Nest near Waynesville. Jackson County: Balsam. TENNESSEE. Carter County: Roan Mountain.

Specimens with curled hairs only:

CANADA. ONTARIO. Aylmer, Cape Croker on Bruce Peninsula, Fort William on Loon Lake, Collingwood on Georgian Bay, Tobermory, Toronto, Windsor. QUEBEC. La Trappe, Oka, Ottawa (*F. Marie-Victorin* et al. 45816).

MEXICO. COAHUILA. Sierra del Carmen.

UNITED STATES. ALABAMA. Clay, Cullman, Jefferson (*Harper* 3678), Madison, St. Clair counties. ARKANSAS. Arkansas, Ashley, Benton, Craighead (*Demaree* 3584), Crawford, Franklin, Garland, Hempstead (*E. J. Palmer* 8035), Hot Springs, Lonoke, Miller, Nevada, and Phillips counties. CONNECTICUT. Fairfield, Hartford (*C. H. Bissell* 2132), Litchfield, New Haven, New London counties. GEORGIA. Cobb, Gwinnett, Stephens counties. ILLINOIS. Cass, Cook (*H. H. Smith* 5662), Du Page, Hancock, Henderson, Jackson, Jo Daviess (*M. Lodewyks* 403), Kane, Kankakee (*Sherff* 1602), Lake, La Salle (*H. Lewis* 13), McLean, Mason, Morgan, Richland, St. Clair, Winnebago counties. INDIANA. Benton, Blackford, Clark, Clinton, Crawford, De Kalb, Elkhart, Hamilton, Harrison, Jasper, Lagrange, Lake (*Lansing* 2538), Lawrence, Pike, St. Joseph counties. IOWA. Black Hawk (*Burk* 562), Clayton (*Pammel* 626), Decatur, Des Moines, Emmet, Fayette, Greene, Henry (*C. Ball* 1583), Johnson (*A. S. Hitchcock* 1889), Muscatine, Polk, Story, Van Buren (*E. Graves* 1690), Winneshiek counties. KANSAS. Allen, Anderson, Atchison, Bourbon, Brown, Butler, Chase, Cherokee (*N. B. Jacobs* 127), Clay (*C. Weber* 295), Cloud, Coffey, Cowley, Crawford, Dickinson, Doniphan, Douglas, Elk, Ellis (*Rydberg and Imler* 1221), Franklin, Geary, Jackson, Johnson, Labette, Leavenworth, Linn, Lyon, McPherson, Marion, Miami (*Oyster,* VII. 1885), Mitchell, Montgomery (*E. J. Palmer* 41789), Morris, Neosho, Osage, Osborne, Pottawatomie, Republic, Riley (*J. Norton* 405), Saline, Sedgwick, Shawnee (*W. A. Dick,* July 1887), Wabaunsee, Washington, Wilson, Woodson and Wyandotte (*C. A. Ripley,* July 1899) counties. KENTUCKY. Caldwell (*E. J. Palmer* 17839), Christian, Fayette, Fulton (*W. A. Anderson* 332), Lyon, Madison, Nelson (*Sister Rose Agnes* 1496), Rockcastle, Wayne counties. LOUISIANA. Natchitoches Parish (*E. J. Palmer* 7975). MAINE. Penobscot County. MARYLAND. Garrett (*Luttman,* August 1934), Montgomery counties. MASSACHUSETTS. Berkshire (*Helen Angell*), Bristol (*Sturtevant,* August 1889), Franklin, Hampden (*F. C. Seymour* 598), Middlesex, Norfolk, Suffolk counties. MICHIGAN. Allegan (*Wight* 36), Cheboygan (*F. Herman* 1959), Clare, Emmet, Genesee, Grand Traverse, Hillsdale, Ingham, Jackson, Mackinac, Manistee (*F. Herman* 2338), Mason (*R. Chaney* 103), Oceana, Roscommon, St. Clair, Schoolcraft, Washtenaw (*C. D. La Rue,* 26. IX. 1915) counties. MINNESOTA. Beltrami (*Moyle* 693), Cass, Clay, Clearwater (*Grant* 3002), Goodhue, Hennepin, Hubbard, Itasca (*A. M. Johnson* 3265), Le Sueur, Otter Tail, Polk, Winona counties. MISSISSIPPI. Simpson County. MISSOURI. Barry, Butler (*Savage and Stull* 1060), Chariton, Clay, Cooper, Dunklin, Greene, Iron, Jackson, Jasper, Laclede, Ozark, Pettis

(*Heller* 13989), Phelps, Pulaski, Ste. Genevieve (*Steyermark* 2067), St. Louis (*Sherff* 736, *Eggert,* August 1886), Shannon, Taney, Warren, Wayne, Webster, Wright counties. NEBRASKA. Banner, Cass (*J. Morrison* 1231), Cherry, Cheyenne, Dawes, Gage, Harlan (*Laybourn* 70), Holt, Hooker, Kearney, Lancaster, Nemaha counties. NEW HAMPSHIRE. Rockingham County (*Batchelder,* September 1927). NEW JERSEY. Bergen, Hudson, Hunterdon, Monmouth, Morris, Passaic, Somerset (*Moldenke* 1338), Sussex, Warren counties. NEW YORK. Albany, Cayuga, Chemung (*Lucy* 8585), Columbia, Dutchess, Hamilton, Herkimer, Jefferson, Nassau, Ontario (*J. Hall,* 1828–1834), Orange, Richmond, St. Lawrence, Saratoga, Schuyler, Tioga, Tompkins, Ulster, Warren, Washington, Westchester, Yates (*J. A. Drushell* 6202) counties. NORTH CAROLINA. Buncombe (*Biltmore Herbarium* 6526), Haywood, Henderson, Jackson, Montgomery, Swain counties. NORTH DAKOTA. Bottineau, Rolette counties. OHIO. Ashtabula (*Greenman* 1416), Lake, Lorain, Lucas, Ottawa, Portage, Ross (*Demaree* 11503), Trumbull counties. OKLAHOMA. Carter, Cleveland, Comanche, Johnston, Le Flore (*E. J. Palmer* 8289), McClain, Murray, Ottawa (*Goodman* 2141), Payne, Pottawatomie counties. PENNSYLVANIA. Bucks, Chester, Columbia, Delaware, Franklin, Lehigh, Montour, Pike counties. RHODE ISLAND. Providence County. SOUTH DAKOTA. Brookings, Grant, Union counties. TENNESSEE. Carroll, Carter, Chester, Davidson, Decatur, Dickson, Franklin, Hamilton, Knox (*Ruth* 535), Morgan, Roane, Sevier, Sumner (*Eggert,* August 1897) counties. TEXAS. Bowie (*Heller* 4174), Cass, Dallas, Erath (*E. J. Palmer* 14173), Harris (*Tharp* 2547), Hays (*Palmer* 12104), Jeff Davis, Lamar, Montague, Tarrant, Taylor, Travis counties. VERMONT. Addison (*Brainerd,* August 1900), Bennington, Caledonia (*Blanchard,* August 1883), Rutland, Windsor counties. VIRGINIA. Bath, Rockbridge, Carroll, Craig (*Steele* 129), Giles counties. WEST VIRGINIA. Calhoun, Mercer, Mingo (*Berkeley* 1002), Pendleton (*Berkeley* 1534), Pocahontas, Wayne (*Gilbert* 603) counties. WISCONSIN. Door (*Millspaugh* 3601), Iowa, Kenosha, La Crosse, Oneida, Pierce, Polk, Sauk, Walworth, Waupaca (*Garishe* 1907) counties.

Specimens with both curled and spreading hairs:

CANADA. ONTARIO. Kingston (*A. B. Ford,* July 1893), Leamington, Wasaga Beach on Georgian Bay. QUEBEC. La Trappe, Oka.

UNITED STATES. ALABAMA. Cullman, Madison (*Harper* 3411), St. Clair counties. ARKANSAS. Craighead (*Demaree* 7013), Drew, Logan, Pulaski counties. CONNECTICUT. Fairfield, Hartford, Litchfield, New London, Tolland, Windham counties. GEORGIA. Rabun County (*Small,* August 1893). ILLINOIS. Cook, Henderson, Lake, Peoria counties. INDIANA. Cass, Decatur, Elkhart, Fulton, Jasper, Lake, Martin, Perry counties. KANSAS. Douglas, Ellsworth, Saline, Wabaunsee counties. LOUISIANA. Natchitoches, Rapides (*Ball* 612) parishes. MAINE. Penobscot, York counties. MARYLAND. Cecil, Montgomery counties. MASSACHUSETTS. Berkshire, Essex, Middlesex, Norfolk, Revere counties. MICHIGAN. Benzie, Cheboygan, Dickinson, Emmet, Gratiot, Kent, Wayne counties. MINNESOTA. Hennepin County. MISSOURI. Barry, Christian (*Steyermark* 23167), Greene, Jasper, Lewis (*Steyermark* 25726), Lincoln, Marion, Ralls, Stone (*Steyermark* 22635) counties. NEW HAMPSHIRE. Cheshire, Hillsboro, Rockingham counties. NEW JERSEY. Ocean, Morris counties. NEW YORK. Cayuga, Herkimer, St. Lawrence, Steuben, Tompkins counties. NORTH CAROLINA. Buncombe, Forsyth, Guilford, Haywood, Swain counties. OHIO. Erie, Lucas, Scioto counties. PENNSYLVANIA. Allegheny, Franklin, Snyder (*Rothrock,* August 1862) counties. TENNESSEE. Blount, Chester, Cocke counties. VERMONT. Addison, Bennington, Rutland counties. VIRGINIA. Campbell, Carroll, Frederick (*James Hall,* 1828–1834) counties. WEST VIRGINIA. Pendleton, Pocahontas counties. WISCONSIN. Adams, Brown, Burnett, Chippewa, Juneau, Milwaukee, Oconto, Oneida, Racine, Shawano, Sheboygan counties.

7. **M. menthaefolia** Grah.

M. menthaefolia Grah., Edinb. N. Phil. Jour. 347, 1829, based upon garden specimens grown at the Edinburgh Botanical Garden from seeds sent by Drummond from "Norway House on the Saskatchewan" and compared with plants collected by him at the same locality; the type is presumably at Edinburgh.

M. stricta Wooton, Bull. Torr. Bot. Club 25: 263, 1898; type collected by E. O. Wooton (no. 267) in the White Mountains, Lincoln County, New Mexico (U. S. Natl. Herb.).

M. comata Rydb., Bull. Torr. Bot. Club 28: 502, 1901; type collected by Rydberg and Vreeland (no. 5673) on Wahatoya Creek in southern Colorado (N. Y. Bot. Gard.).

M. Ramaleyi A. Nels., Bot. Gaz. 31: 398, 1901; type collected by Frances Ramaley (no. 92) near Boulder Creek, Colorado (Rocky Mountain Herb.).

M. mollis var. *menthaefolia* Fern., Rhod. 3: 15, 1901, based upon *M. menthaefolia* Grah., *loc. cit.*

Perennial herbs, usually 30–75 cm. tall, occasionally as tall as 100 cm., their stems simple, rarely branched, prevailingly pubescent in the upper parts with small downwardly curled hairs and glabrous below, or the entire stem glabrous, the hairs less often longer and tending to spread or to form a tomentum, or even widely spreading and pilose; largest leaves prevailingly ovate-lanceolate, tending to ovate or to lanceolate, commonly about as long as the internodes which they subtend, less often half as long or twice as long or more, usually borne at the third to the fifth node below the glomerule, rarely the second node, 3.5–9 cm. long, 1–3.5 cm. broad, broadest about .5–2 cm. above the base, all leaves serrate, or less often subentire particularly in the narrow-leaved forms, the upper surfaces softly hirtellous with more or less appressed hairs or glabrous, rarely hirsute with longer hairs, rarely softly pubescent and similar to the lower surfaces, the lower surfaces usually pubescent with curled hairs, sometimes subtomentose; median petioles mostly 2–5 mm. long, rarely as long as 12 mm. usually pubescent with short appressed hairs; glomerules 1.5–2.5 cm. broad, excluding the corollas, the outer bracts subfoliar, frequently pink tinted, reflexed rather than spreading; calyces mostly 7–10 mm., rarely 11–12 mm., occasionally pink tinted, puberulent with short spreading hairs, the teeth 1 mm. long, acuminate, the orifice hirsute within, with stiff, erect hairs, shorter than the calyx teeth, sometimes bristling with similar spreading hairs at the base of the teeth; corolla lavender or rose-purple, prevailingly 26–33 mm. long, rarely as long as 38 mm., pubescent with short curling hairs, the upper lip comose, the tube 16–22 mm. long, rarely 25 mm. long, usually twice as long as the calyx, gradually expanded upward; stamens seated 1–3 mm. within the tube.

M. menthaefolia is fairly constant in most respects (fig. 7). The pubescence is of two types. The most widespread type is that with short downwardly curled hairs. The least common type consists of longer spreading pili and has been named *M. comata*. It occurs only in southern Colorado and adjacent New Mexico, and at Fort Rupert on Vancouver Island in British Columbia. Both pubescence types can be found on the same plant. It was to such a form collected at Boulder Creek, Colorado, that the name *M. Ramaleyi* was given. *M. stricta* is a name given to a plant collected in the White Mountains of Lincoln County, New Mexico. This form bears short downwardly curled hairs and has a slender stem with narrow leaves. Both fall clearly within the range of variation of *M. menthaefolia*. *M. stricta* has its homolog in the slender small forms of *M. fistulosa* which occur in the southeastern United States.

Distribution.—Specimens with curled hairs only (see fig. 9):

CANADA. ALBERTA. Calgary, Fenn, Rosedale (*Moodie* 1108). BRITISH COLUMBIA. Erie in the Salmo District, Taylor in the Peace River Valley, Vernon (*Murie* 1206). MACKENZIE. Wood Buffalo Park in the Mackenzie Basin. MANITOBA. Mount Royal (*S. L. Thompson* 33). SASKATCHEWAN. Lipton (*Clokey* 1688), Hershel, Moose Jaw, Saskatoon (*Macoun and Herriot* 78047).

UNITED STATES. ARIZONA. Cochise (*Blumer* 1544), Coconino (*Purpus* 8074, *MacDougal* 258), Gila, Graham, Greenlee, Navajo, Pima (*Blumer* 3302), Santa Cruz (*Peebles and Harrison* 2965), Yavapai counties. COLORADO. Archuleta, Boulder, Delta, El Paso (*Clements* 139), Fremont, Gilpin, Huerfano, Jefferson (*Clokey* 3859), La Plata (*Baker*,

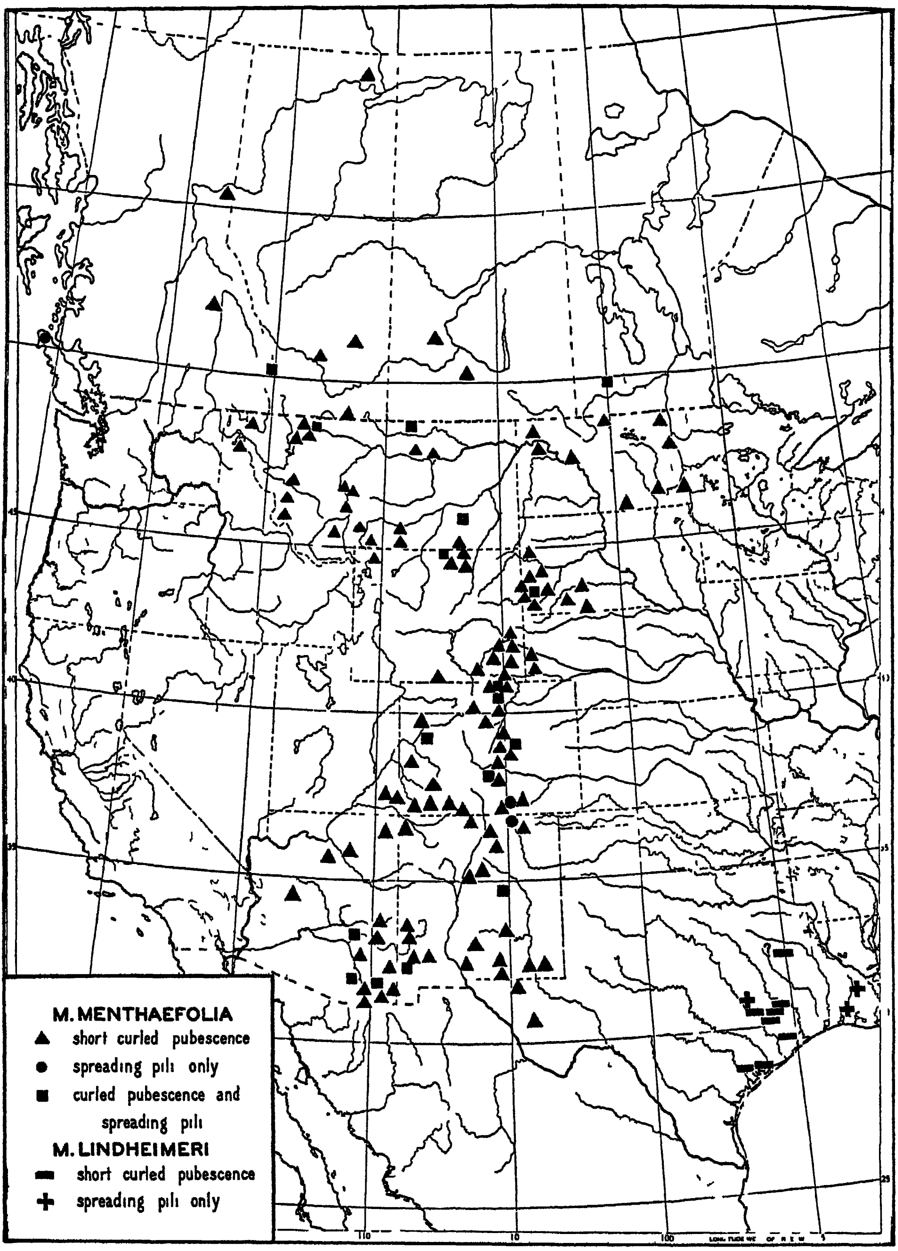
M. MENTHAEFOLIA
▲ short curled pubescence
● spreading pili only
■ curled pubescence and spreading pili
M. LINDHEIMERI
▬ short curled pubescence
+ spreading pili only
45
40
35
25
110
10
100

Fig. 9. Distribution of *M. menthaefolia* and *M. Lindheimeri.*

Earle, and Tracy 505), Montrose (*Payson* 509), Ouray, Pitkin, Rio Blanco, Routt and San Miguel (*Walker* 406) counties. IDAHO. Boundary, Kootenai (*Heller* 817) counties. MONTANA. Blaine, Carbon, Cascade, Custer, Flathead, Gallatin (*Flodman* 756, *Blankinship* 417), Glacier, Lake, Lewis and Clark, Lincoln, Madison (*Rydberg and Bessey* 4401), Missoula (*Kirkwood* 1291), Park, Phillips, Stillwater, Yellowstone counties. NEW MEXICO. Bernalillo, Catron, Colfax (*Standley* 13948), Dona Ana, Eddy (*Grasse* 54), Grant (*Eggleston* 16021), Lincoln (*Wooton* 267), Otero, Rio Arriba (*C. F. Baker* 570), San Miguel (*Standley* 4413), Santa Fe (*Heller* 3798), Socorro, Taos counties. NORTH DAKOTA. Barnes, Bottineau, Cass, Grand Forks, McIntosh, Pembina (*Bergman* 2274), Rolette, Ward, Williams (*E. J. Palmer* 36918) counties. SOUTH DAKOTA. Brookings, Custer, Fall River, Harding, Lawrence, Meade, Mellette, Pennington, Washabaugh counties. TEXAS. Culberson (*Moore and Steyermark* 3645), Jeff Davis (*E. J. Palmer* 34546) counties. UTAH. San Juan County. WYOMING. Albany (*Nelson* 7364), Carbon (*Goodding* 1746), Goshen, Johnson, Laramie, Lincoln, Platte, Sheridan (*Pammel and Stanton* 305, *Nelson* 8468), Weston counties.

Specimens with both curled and spreading hairs:

CANADA. ALBERTA. Crown Nest Pass. MANITOBA. Brandon.

UNITED STATES. ARIZONA. Gila (*Collom* 151), Graham, Pima counties. COLORADO. Boulder (*Ramaley* 877), El Paso, Fremont, Larimer, Pitkin counties. MONTANA. Flathead and Rosebud counties. NEW MEXICO. Catron County. SOUTH DAKOTA. Lawrence County (*Carr* 36). WYOMING. Sheridan County (*Pammel and Stanton* 312).

Specimens with spreading pili only:

CANADA. BRITISH COLUMBIA. Fort Rupert on Vancouver Island (*Hunt*, ann. 1904. ? introduced).

UNITED STATES. COLORADO. Huerfano County (*C. L. Shear* 3636). NEW MEXICO. Colfax County (*Eggleston* 18995).

8. **M. Lindheimeri** Engelm. and Gray

M. Lindheimeri Engelm. and Gray, Bost. Jour. Nat. Hist. 5: 228, 1847; type collected by F. Lindheimer (no. 151) in Texas, probably near Houston (Gray Herb.).

M. hirsutissima Small, Flora SE. U. S., 1037, 1903; type collected in "Texas" by an unknown collector, said to have been in the Chapman Herbarium. It is highly probable that the specimen was collected in prairies at Opelousas, Louisiana, by V. M. Carpenter; such a specimen from the Short Herbarium, now at the Philadelphia Academy of Sciences, is remarkably like the type, as well as a specimen by the same collector in the herbarium of the University of Wisconsin.

Perennial herbs 30–60 cm. tall, their stems simple or branched, glabrous or finely pubescent with downwardly curled hairs or rarely densely covered with longer stiffish spreading hairs; the largest leaves prevailingly ovate, occasionally ovate-lanceolate, varying from one-half to two times as long as the internodes which they subtend, usually borne at the second to the sixth node below the glomerule, 3–5 cm. long, usually 1.5–2.5 cm. broad but as much as 4 cm. broad, broadest from .5–1 cm. above the base of the leaf, glabrous or minutely puberulent or rarely covered like the stem with dense spreading hairs; all leaves serrate or occasionally subentire, particularly the upper pair; median petioles mostly less than 5 mm., infrequently as long as 9 mm.; glomerules 2–5 cm. broad, excluding the corollas, the component branches visible, at least in older specimens, as much as 12 mm. long, the outer bracts subfoliar, usually reflexed; calyces 9–13 mm. long, puberulent with short spreading hairs, the teeth 1–2 mm. long, acuminate, the orifice hirsute within with stiff erect hairs, sometimes bristling with stiff spreading hairs at the base of the teeth; corolla seemingly pallid, 17–30 mm. long, pubescent with short curling hairs, the upper lip comose, the tube 11–19 mm. long, gradually expanded upward, the stamens seated 1–2 mm. within the tube.

Apart from the actual range in size, the chief variation in *M. Lindheimeri* is that of the pubescence (fig. 8). The usual type is of short downwardly curled hairs. It was to this form that the name was first applied. The pilose form is known only from Louisiana, near Opelousas and near Holmwood. Two specimens have been collected in Brazos County, Texas, in which, in addition to the short hair, a few spreading pili are present. While similar to *M. fistulosa* in many respects and merging with it, this species nevertheless bears a stronger resemblance to *M. menthaefolia,* from which it is geographically isolated. A specimen collected at Atlanta, Cass County, Texas, by E. J. Palmer (no. 2715) has the foliage of *M. fistulosa,* the glomerules, flowers, and spreading pubescence of *M. Lindheimeri.*

Distribution.—Specimens with curled hairs (see fig. 9):

Texas. Brazos (*E. J. Palmer* 13430), Harris (*Reverchon* 3911), ?Smith, Walker, Waller (*Elihu Hall* 449) counties.

Specimens with spreading pili:

Louisiana. St. Landry Parish: Opelousas (*Carpenter*). Calcasieu Parish: Holmwood (*Correll and Correll* 9572).

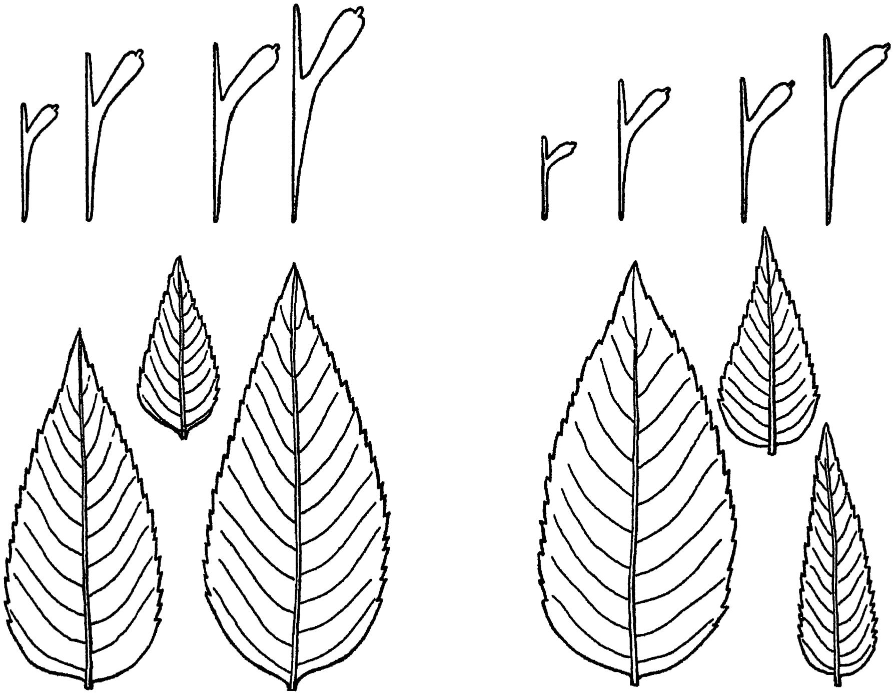

Fig. 10. Approximate diagrammatic range in variation in proportion and size of the corollas and leaves of *M. media* (left) and *M. clinopodia* (right). The corollas on the left of each group represent the small-flowered forms, mentioned in the text, and those on the right represent the large-flowered form.

9. **M. media** Willd.

M. media Willd., Enum. Hort. Berol. 1: 32, 1809, based upon a garden specimen; the probable type is preserved in the herbarium of the Botanical Institute at Berlin-Dahlem.

M. fistulosa var. *media* Gray, Syn. Fl. N. Amer. 2: 374, 1878, based upon the same.

Perennial herbs commonly 50–125 cm. tall, their stems mostly branched in the upper parts, thinly pubescent in the inflorescence with downwardly curled or somewhat spreading hairs, glabrous below or thinly sprinkled with slender pili; largest leaves one to two times as long as the internodes which they subtend, usually borne at the third to the fifth node below the glomerule, ovate to deltoid-ovate, 6.5–12 cm. long, 3–6 cm. broad, the broadest part of the leaf 3–6 cm. above the base, all leaves serrate, thinly hirsute above with scattered slender appressed hairs, more densely so beneath, with longer, stiff and spreading or somewhat curled hairs, especially along the veins; median petioles 1–3.5 cm. long, hirsute with spreading hairs; glomerules 2–2.5 cm. broad, excluding the corollas; outer bracts subfoliar, tinted with reddish purple, spreading or reflexed; calyces 8–10 mm. or rarely 12 mm. long, tinted with reddish purple, the tube and the teeth puberulent with minute spreading hairs, the teeth 1 mm. long, the orifice bearing a few slender spreading hairs; corolla rose purple, 18–27 mm. long, pubescent with slender curling hairs, the upper lip not bearded, the tube 13–17 mm. long, two-thirds to three-fourths the length of the entire corolla, gradually expanded upward; stamens seated about 1 mm. within the throat.

Except for the differences in size of the leaves and corollas, *M. media* varies but little (fig. 10). The corolla lengths range from 18–34 mm. There is apparently no geographic segregation of these forms. The stamens are seated from 1–2 mm. within the throat. The upper lip may be almost glabrous or pubescent but is not comose. While separable from *M. clinopodia* chiefly in corolla color, it is confluent with *M. fistulosa* through *M. fistulosa* var. *rubra*, from which the larger-flowered forms may be distinguished chiefly by the comose upper lip of var. *rubra*.

Distribution (see fig. 11).—CANADA. Ontario. Wingham (*Morton* 5523).

UNITED STATES. Delaware. New Castle County. Indiana. Wells (*Deam*, July 1904). Maine. Cumberland County. Maryland. Cecil, Garrett (*Steele* 85), Prince Georges (*Fr. Hyacinth* 1654) counties. Massachusetts. Norfolk, Middlesex counties. New York. Cattaraugus (*Alexander and House* 12789), Chemung (*Lucy* 10816; 8585), Tompkins (*Wiegand* 7078), Ulster counties. North Carolina. Buncombe, Haywood, Jackson (*Rydberg* 9432; 9492) counties. Ohio. Cuyahoga (*Greenman* 1401), Portage (*Ganong* 1405) counties. Pennsylvania. Allegheny, Armstrong, Columbia, Dauphin (*Williamson* 1583), Lackawanna, Lehigh, Luzerne (*Heller*, July 1889), Northampton (*Porter*, July 1891) counties.

10. **M.** clinopodia L.

M. clinopodia L., Sp. Pl. 1: 22, 1753, based upon a garden plant in the Linnean Herbarium, thus annotated by Linneus; the Gronovian plant referred to by Linneus is apparently lost.

M. allophylla Michx., Fl. Bor. Amer. 1: 16, 1803; a specimen is preserved in the Michaux herbarium at Paris.

Perennial herbs 30–125 cm. tall, their stems simple or branching in the upper parts, glabrous or thinly sprinkled with slender spreading pili or thinly pubescent with downwardly curled hairs; largest leaves one-half to three times as long as the internodes they subtend or longer, borne at the second to the sixth node below the glomerule, most frequently at the second or third, ovate to deltoid-ovate, 5–13 cm. long, 2.5–6 cm. broad, the broadest part of the leaf 1–3.5 cm. above the base, all leaves serrate, thinly hirsute above with scattered slender appressed hairs, more densely so beneath with longer stiff and spreading or somewhat curled hairs, especially along the veins; median petioles 1–3 cm. long, hirsute with spreading hairs; glomerules 1.5–3 cm. broad, excluding the corollas; outer bracts subfoliar, green, or the midrib purple; calyces 6–10 mm. long, green, the tube and the teeth glabrous or puberulent with minute spreading hairs, the teeth 1 mm. long, the orifice bearing a few spreading hairs; corolla whitish with purple spots, 14–30 mm. long, glabrous or pubescent with short slender curling hairs, the upper lip not bearded, the stamens seated about 1 mm. within the tube, the tube 8–21 mm. long, gradually expanded upward.

The chief variation in *M. clinopodia* is found in the length of the corollas (fig. 10). This is the only species in which the frequency distributions of that character, when plotted graphically, suggest the possibility of a bimodal curve. The smaller of these modes is 19 mm. and the larger is 25 mm. While these two forms are not separated geographically there is a tendency for the large-flowered forms to occur in the Ohio River Valley and the small flowered forms to occur on the Atlantic coast.

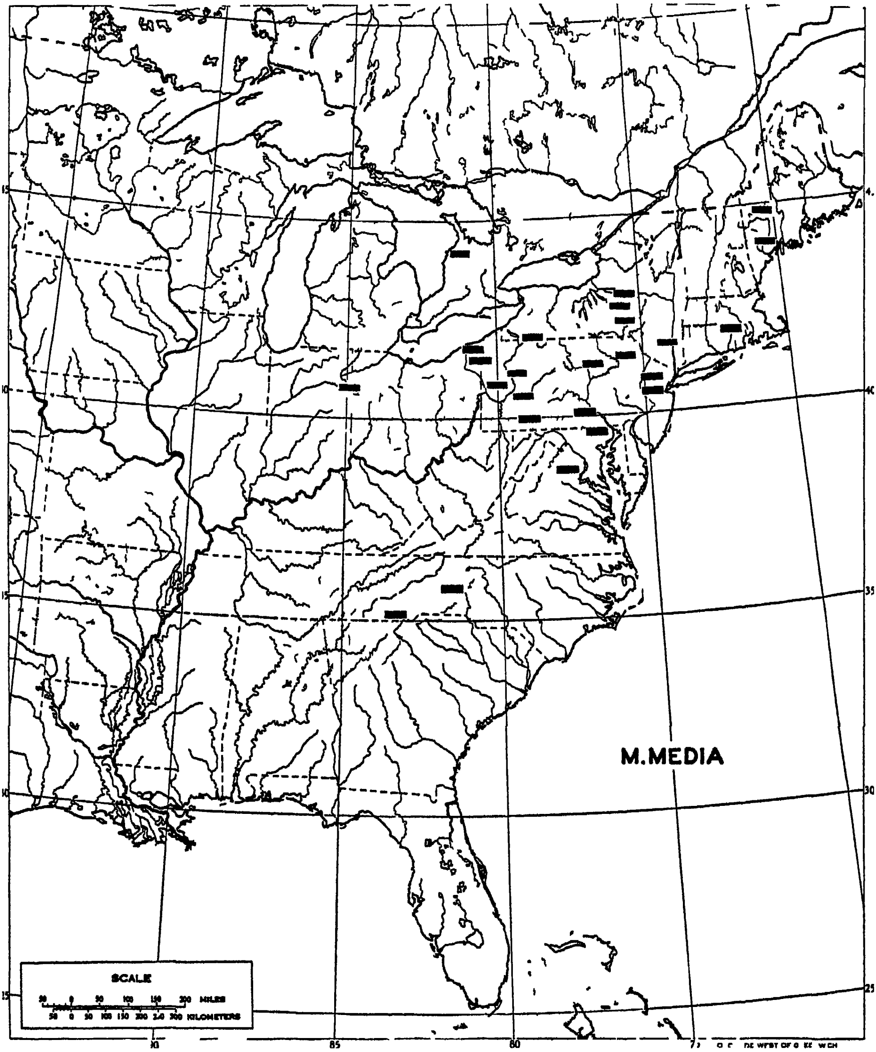

Fig. 11. Distribution of *M. media.*

There is some variation in stem pubescence. The stems may be glabrous or nearly so but sprinkled with widely spreading hairs, or they may be hirsute with long, somewhat curling hairs, or pubescent with shorter hairs. The shorter hairs, however, are of a different aspect from those of *M. fistulosa.*

Distribution (see fig. 12).—ALABAMA. Tuscaloosa County (*Harper* 3662). CONNECTICUT. Fairfield, New Haven, New London counties. DELAWARE. New Castle County. ILLINOIS. Marion, Macon, Stark, Tazewell (*Frank McDonald,* July 1889) counties. INDIANA. Adams, Bartholomew, Browne, Clay, Crawford, Franklin, Grant, Harrison, Hendricks, Jackson, Jefferson, Jennings, Marion, Monroe, Montgomery, Ohio, Orange, Owen, Posey, Ripley, Wells (*Deam*, July 1897), Wayne counties. KENTUCKY. Carter, Edmonson, Estill, Fayette, Harlan

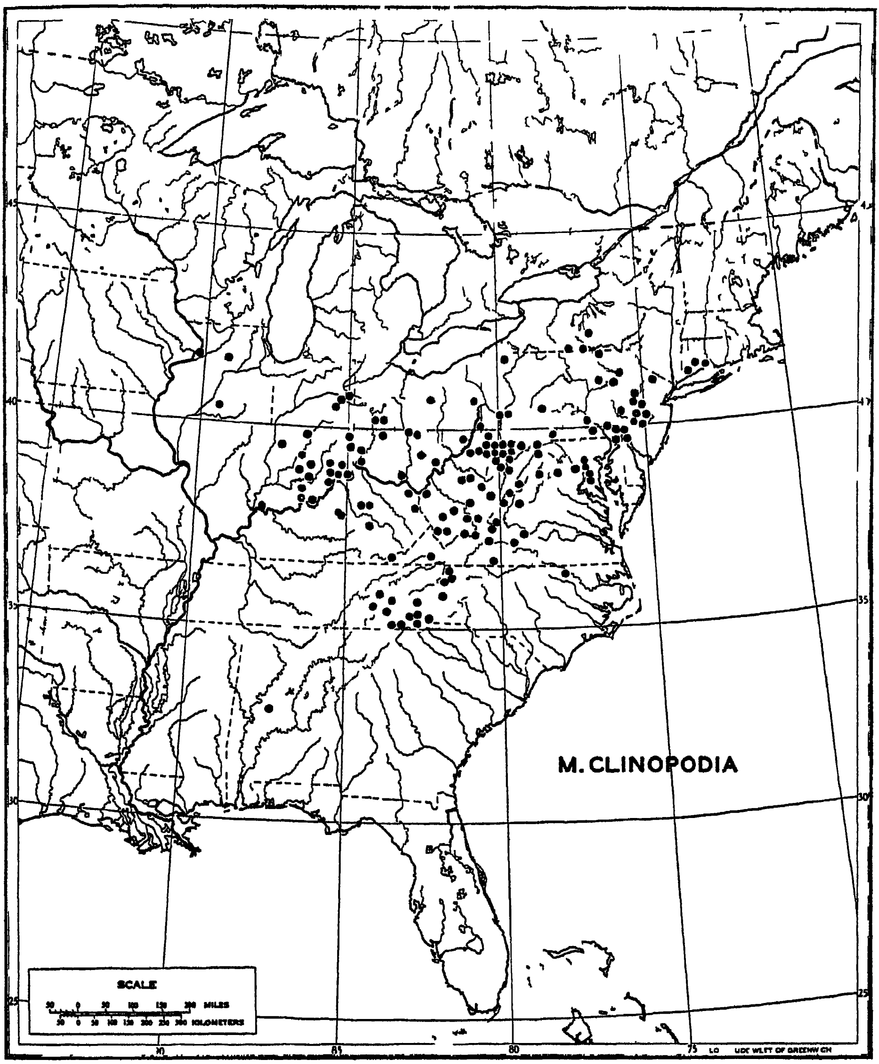

Fig. 12. Distribution of *M. clinopodia.*

(*Kearney* 162), Jessamine, Lawrence, Madison counties. MARYLAND. Allegheny, Cecil, Garrett, Montgomery counties. NEW JERSEY. Hunterdon, Sussex counties. NEW YORK. Chemung (*Lucy* 8582), Erie (*A. E. Perkins* 314), Livingston, Steuben, Tompkins, Westchester counties. NORTH CAROLINA. Avery, Buncombe (*Biltmore Herbarium* 4216), Burke, Caldwell (*Small and Heller* 107), Alexander, McDowell, Macon, Polk, Swain (*Beardslee and Kofoid*, July 1891), Watauga counties. OHIO. Butler, Columbiana, Cuyahoga (*Greenman* 1405), Franklin, Greene (*Demaree* 11461*a*), Hamilton, Meigs, Miami, Monroe, Richland, Scioto counties. PENNSYLVANIA. Allegheny, Berks, Blair, Bradford, Bucks, Chester, Columbia, Delaware, Lackawanna, Lancaster (*Heller*, July 1901), Luzerne, Montgomery, Northampton, Philadelphia, York counties. TENNESSEE. Blount, Cocke, Knox, Sevier counties. VIRGINIA. Augusta, Bath, Bedford, Campbell, Carroll, Craig, Fairfax, Giles, Highland, Page (*Steele* 56), Patrick, Pulaski (*Small*, July 1892), Rockbridge, Shenandoah, Smyth counties. WEST VIRGINIA. Boone, Cabell, Calhoun, Harrison, Kanawha, Marion, Mercer (*Berkeley* 1150), Mineral, Monongalia, Ohio, Preston, Randolph, Summers, Upshur, Webster counties.

2. SUBGENUS **Cheilyctis**

Monarda sect. *Cheilyctis* Raf., Med. Fl. 2: 64, 1830; *M. punctata* may be taken as the standard species.

Cheilyctis Raf., Journ. Phys. 89: 99, 1819.

Monarda sect. *Coryanthus* Nutt., Trans. Amer. Phil. Soc. 5: 186, 1834.

Annual or perennial herbs of erect habit and intermediate size with lanceolate or oblong petiolate leaves; glomerules several, disposed in an interrupted spike, subtended by bracts which usually form an involucre partly enclosing the calyces or which may be wholly reflexed, usually colored, the outer foliar, all more or less ciliate toward the base; calyx 13- or 15-veined, the teeth deltoid or aristate, equal; corolla tube slender, cylindrical, rather abruptly expanded to form a funnel-shaped throat in which is found a tuft of hair beneath the lower lip, the unexpanded portion barely exserted from the calyx, the upper lip strongly galeate and arched, about equal to the lower lip, the limb somewhat shorter than the tube; the stamens usually seated at the base of the throat, strongly arched and ascending under the galea, usually included under the upper lip; upper style branch usually shorter than the lower.

Cheilyctis differs from *Eumonarda* chiefly in habit of foliage, the often annual habit, the inflorescence, and the proportions of the corollas, particularly the arching of the upper lip and the relatively short throat. The pubescence of both subgenera is similar and relatively long bristlelike hairs appear in both. The specific differences in pubescence within the section are of about the same magnitude. The specific differences in foliage are expressed largely by differences in the modal size of the leaves. The corollas are similar in proportion and size throughout the subgenus, but vary in coloring. However, the absolute sizes, notably the length of the corolla tube, and the relative proportions of the expanded and unexpanded portions of the tube, appear to be specific or subspecific characteristics. The means in leaf and corolla proportions of each species and subspecies are contrasted diagrammatically in figure 13. Apart from these modal differences, the principal basis for specific differentiation lies in the nature of the bracts and calyx teeth. While these characteristics form an overlapping pattern to some extent, they are generally distinguishable.

Two series appear in the subgenus which have been designated as Sections *Aristatae* and *Foliosae*. They are characterized by differences in bracts and in calyx teeth. Speciation has seemingly progressed further in the former. *M. mexicana* has the flowers of *Cheilyctis* but suggests *Eumonarda* in habit. It is known from only a single specimen. It comes closer, perhaps, to *M. Russeliana* than to any other species of *Eumonarda*.

The relative distribution of each species of *Aristatae* is shown in outline in figure 15. The relative distribution of the species and subspecies of *Foliosae* may be seen in figure 14.

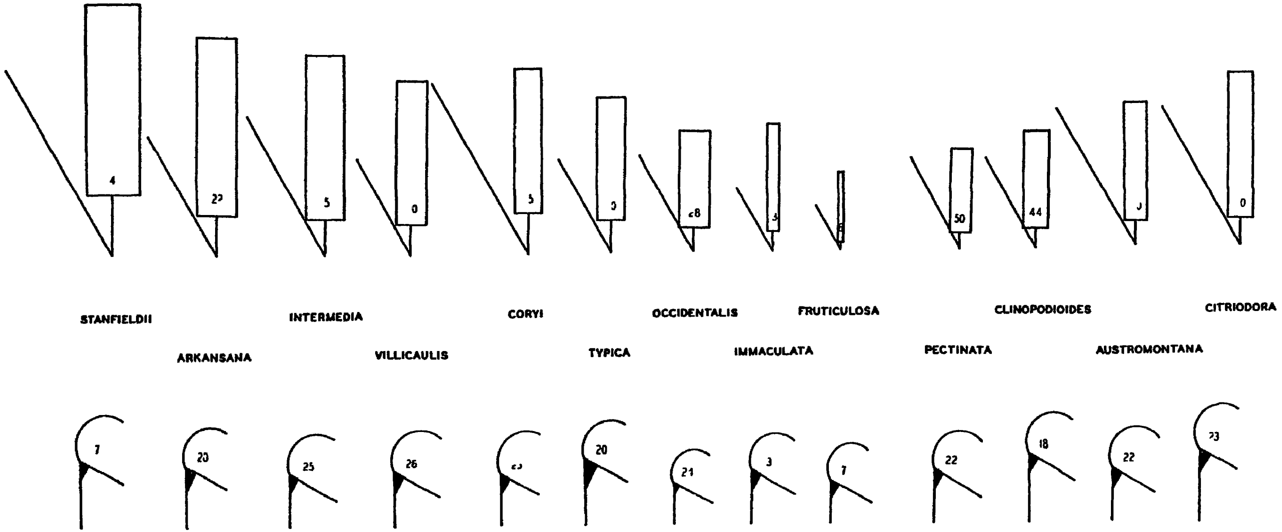

Fig. 13. The mean differences of the leaf size (above) and corolla proportions (below) of the species and subspecies of *Cheilyotis*. The lengths of the upper and lower lips of the corolla, as diagrammed, are not significant. The bar to the left of the diagram of the leaf blade represents the mean internode length subtended by the largest leaf, which was the one measured. The numerals refer to the number of items measured.

KEY TO THE SPECIES

Calyx teeth deltoid, sometimes narrowly so, more or less acuminate, rarely subulate, but not at all aristate, twice as long as broad, rarely more, sometimes less; bracts more or less foliar, not aristate.

> Leaves not more than 3 mm. broad, entire, or toothed only near the apex, canescent on both surfaces with minute hairs; calyx tube not over 5 mm. long.....12. **M. fruticulosa**
>
> Leaves 3 mm. broad or more, rarely entire, usually remotely serrate, sometimes sharply so, pubescent or glabrous on the upper surface but green, the lower surface variously pubescent; calyx tube rarely less than 5 mm. long.
>
> > Calyx teeth subulate, 1.5 mm. long; leaves which subtend glomerules 10–20 mm. broad at the base; plants of Durango........................13. **M. mexicana**
> >
> > Calyx teeth deltoid, blunt or acuminate, hardly subulate; leaves which subtend the glomerules infrequently wider than 10–12 mm.; plants of the eastern United States.
> >
> > > Calyx teeth deltoid, almost as broad as long, mostly acute; leaves commonly 30–40 mm. long, 10–12 mm. wide, evenly pubescent on the lower surface; corollas pink or white, the throat 3–4 mm. long; annual plants of western Texas and Oklahoma, extending to New Mexico and Chihuahua
> > > 11*g*. **M. punctata** subsp. **occidentalis**
> > >
> > > Calyx teeth narrowly deltoid, usually acuminate, rarely as broad as long, usually twice as long as broad; leaves usually longer but if as short, usually much narrower; corollas yellowish, sometimes pink or white; usually (?) perennial or biennial plants.
> > >
> > > > Leaves linear-lanceolate, usually sharply serrate, rarely more than 7 mm. wide, usually 30–50 mm. long; corolla unspotted (? pinkish); plants of the Texan prairies from Houston County southwestward, occurring also in Hidalgo County...............11*h*. **M. punctata** subsp. **immaculata**
> > >
> > > > Leaves lanceolate or oblong-lanceolate, rarely as little as 7 mm. broad, usually 50–70 mm. long and 10–15 mm. broad; corollas usually yellowish and purple-punctate, sometimes apparently pinkish and unspotted.
> > > >
> > > > > Upper leaf surface thinly pubescent, the lower densely covered throughout with curled hairs, even tomentose and silvery; stems villous with curled or spreading hairs; corolla yellowish and purple-punctate, the throat 4–5 mm. long; plants found mostly north of the Ohio River and east of the Mississippi, occurring also in northern New York and Vermont.....11*c*. **M. punctata** subsp. **villicaulis**
> > > > >
> > > > > Upper leaf surface mostly glabrous, the lower evenly pubescent with short hairs or glabrate, or bearing longer curled hairs chiefly along the midvein, never evenly tomentose; stems pubescent with small curled hairs with which longer bristlelike hairs may also occur; corolla yellowish or (?) pinkish.
> > > > >
> > > > > > Corolla throat prevailingly 5–6 mm. long, the unexpanded portion of the tube mostly 6–8 mm. long; corollas yellowish, purple-punctate; stems bearing curled hairs along the midvein beneath, similar to those of subsp. *villicaulis* but not covering the whole leaf, or absent.
> > > > > >
> > > > > > > Leaf-blades commonly 60–80 mm. long; bristles rarely absent from the stem, often dense; plants of Arkansas
> > > > > > > 11*b*. **M. punctata** subsp. **arkansana**
> > > > > > >
> > > > > > > Leaf-blades commonly 40–50 mm. long, bristles infrequent; plants of the Atlantic and Gulf seaboards from New Jersey to Mississippi...........11*a*. **M. punctata** subsp. **typica**

Corolla throat prevailingly 4–5 mm. long, the unexpanded portion of the tube mostly 5–11.5 mm. long; corollas yellowish and purple punctate or (?) pinkish and non-punctate; stems bearing only a close curled pubescence; leaves evenly puberulent on the lower surface with small curled hairs, glabrate above.

Unexpanded portion of the corolla tube 8–11.5 mm. long; calyx tube 7–8 (10) mm. long, the orifice closed by the dense beard; leaf-blades commonly 60–80 cm. long, 15–25 mm. broad; plants apparently confined to Austin and Hayes counties, Texas 11*d*. **M. punctata** subsp. **Stanfieldii**

Unexpanded portion of the corolla tube 5–7 (–8) mm. long; calyx tube 5–7 (–8) mm. long, the orifice hairy but not closed.

Corolla yellowish, purple-punctate; leaf-blades commonly 50–70 mm. long, averaging about as long as the internodes they subtend, commonly 10–15 mm. broad; plants of the Texan prairie, mostly east of the Brazos River 11*f*. **M. punctata** subsp. **intermedia**

Corolla (?) pinkish, non-punctate; leaf-blades commonly 50–60 mm. long, averaging less than the internodes they subtend, commonly 7–12 mm. broad; plants of Texas, confined largely to the Rio Grande plain 11*e*. **M. punctata** subsp. **Coryi**

Calyx teeth aristate.

Bracts oblong or lanceolate, minutely and densely pubescent with white or purple hairs on the inner (or upper) surface, at least toward the tip.

Bracts, except the outermost foliar ones, usually not more than 4 mm. wide, lanceolate or linear-lanceolate, gradually acuminate to a spinose bristle, strongly reflexed, exposing the calyces............................16. **M. austromontana**

Bracts, except the outermost foliar ones, infrequently less than 4 mm. wide, generally oblong and abruptly acuminate to a spinose bristle, rarely strongly reflexed, usually reflexed only from the middle, thus surrounding the calyces with a bowl-like involucre...................................17. **M. citriodora**

Bracts glabrous or nearly so on the inner (or upper) surface, elliptical, tending to ovate.

Calyx teeth stout and stiffish, 4–6 mm. long; bracts bearing usually 2–4 well developed lateral veins in addition to the midvein.........14. **M. clinopodioides**

Calyx teeth slender and not rigid, 2–3 mm., rarely 4 mm., long; bracts bearing usually only 2 lateral veins in addition to the midvein, these not as strongly developed and frequently obscure............................15. **M. pectinata**

Section **Foliosae**

Subsect. *Foliosae* Epl., Madrono 3: 22, 1935. Type species *M. punctata.*

Calyx teeth deltoid, acuminate but not at all aristate, their length seldom more than 3 times their width; calyx veins 13.

11. **M. punctata** L.

M. punctata L., Sp. Pl. 22, 1753. The standard specimen may be taken as that plant of the Linnean Herbarium labeled "flor. verticell. hort cliff. 495."; this is similar to a plant distributed by the Biltmore Herbarium (no. 653*a*), but is evidently a cultivated specimen (see London Jour. Bot., 1929, p. 4).

Perennial, biennial, or annual plants rarely as much as a meter tall, usually less, sparingly branched at the base, or unbranched below the inflorescence, the stems and leaves variously pubescent with curled and sometimes spreading bristlelike hairs, the latter lanceolate, oblong-lanceolate or oblong, petiolate, subentire, or serrate, of varied size, from 1.5–9.5 cm. in length; glomerules commonly 15–25 mm. broad, exclusive of the corollas, subtended by spreading or reflexed whitish or purplish entire bracts, these subglobose to oblong, varied, usually ciliate on the margin near the base, the outer foliar; calyx teeth deltoid, acuminate or even subspinose at the tip, but not at all aristate; corollas yellowish or sometimes (?) pinkish, usually purple dotted.

M. punctata presents a variable complex. This species is readily distinguished from the following ones by the nonaristate nature of the calyx teeth. However, within it a number of geographical races appear, characterized by differences of pubescence, leaf size and habit, and flower size and color. These races do not present many intermediate forms and would probably be recognizable in the field, once known. It may later be found preferable to distinguish some or all of them as species. It is hoped that the outline here presented may serve as a basis for further, more adequate study.

More recent and abundant Texan collections than were formerly available to the senior author, particularly those collected by Parks and Cory, have clearly shown that subsp. *Stanfieldii*, as interpreted by him in an earlier paper, was in fact a complex of several races.

Following are uncertain or questionable specimens:

Specimens collected in Maryland near Beltsville (*McAtee* 1112), at Ellicott City (*Arsene* 690), in the District of Columbia (*Knowlton*, ann. 1885; *Pollard* 609) although of the habit of subsp. *typica*, approximate subsp. *arkansana* in pubescence.

Specimens collected in Tarrant County, Texas, without locality (*Ruth* 478; 1382) have the larger habit of subsp. *intermedia* but calyx teeth which resemble in shape and pubescence those of subsp. *occidentalis*.

Specimens collected in Caddo County, Oklahoma, near Chickasaw P. O. (*Demaree* 13126), at Colbert's Station (*Sheldon* 110), and between the Verdigris and Arkansas rivers (*Blankinship*, August 1895) have the habit of subsp. *villicaulis* but a diminished pubescence on the lower leaf surface. A similar specimen was collected at Roxton, Lamar County, Texas (*Parks and Cory* 20757).

A specimen collected near Houston, Texas (*Fisher* 5073) is apparently subsp. *immaculata* but is inadequate for certain determination.

A specimen collected in Montgomery County, Arkansas, near Norman (*Demaree* 9581), and in Pulaski County near Little Rock (*Demaree* 8192) suggest either subsp. *typica* or subsp. *intermedia*. They are like the Oklahoma specimens mentioned above.

A specimen collected near Columbus, Polk County, North Carolina (*Townsend*, August 1897) is scarcely different from subsp. *arkansana*.

Specimens of *M. p.* subsp. *typica*, collected near Hernando, Florida (*Degener* 5177), and near Punta Rassa (*Standley* 12662) show both upwardly and downwardly curled hairs in the same collection.

Specimens collected in southern Louisiana at Cameron (*Tracy* 8754), at Fort Martinville (*Langlois*, October 1893), and in Texas near Lufkin (*Parks and Cory* 10655) and near Upshur (*Little* 14453; 14455) suggest subsp. *typica* in habit but have pubescence more suggestive of subsp. *arkansana*. At the same time the Texan specimens suggest subsp. *intermedia* except for the longer hairs on the stem. Specimens collected near Silsbee, Hardin County, Texas (*Parks and Cory* 19992; 19993) are apparently subsp. *intermedia*. However, specimens collected at the same time and in the same place have the longer hairs usually not found in this subspecies. A specimen collected at Cypress, Harris County, Texas (*Snyder* 1906) is apparently subsp. *intermedia* but has flowers approaching those of subsp. *typica*.

Specimens collected in Aransas County, Texas, near Rockport (*Parks and Cory* 20395), Goose Island (*Parks* 30697), near Lamar (*E. Palmer* 1081), on Copano Bay (*Tharp* 1553), in Nacogdoches County (*Parks* 33922), and in Refugio County near Austwell (*Tharp* 5583), have seemingly nonpunctate flowers and resemble subsp. *Coryi* and *immaculata* in leaf habit; however, they are hirsute on the stems and even on the leaves, with spreading bristlelike hairs In this respect they suggest subsp *arkansana* The plants seem to have a sprawling habit Perhaps they should be designated as a subspecies Drummond's plant, the type of var *lasiodonta* Gray, may belong to this category

11*a* Subsp **typica** Epl

Subsp **typica** Epl, Madrono 3 23, 1935

M lutea Michx, Fl Bor Amer 1 16, 1803, based upon a specimen now in the herbarium of the Jardin des Plantes, Paris

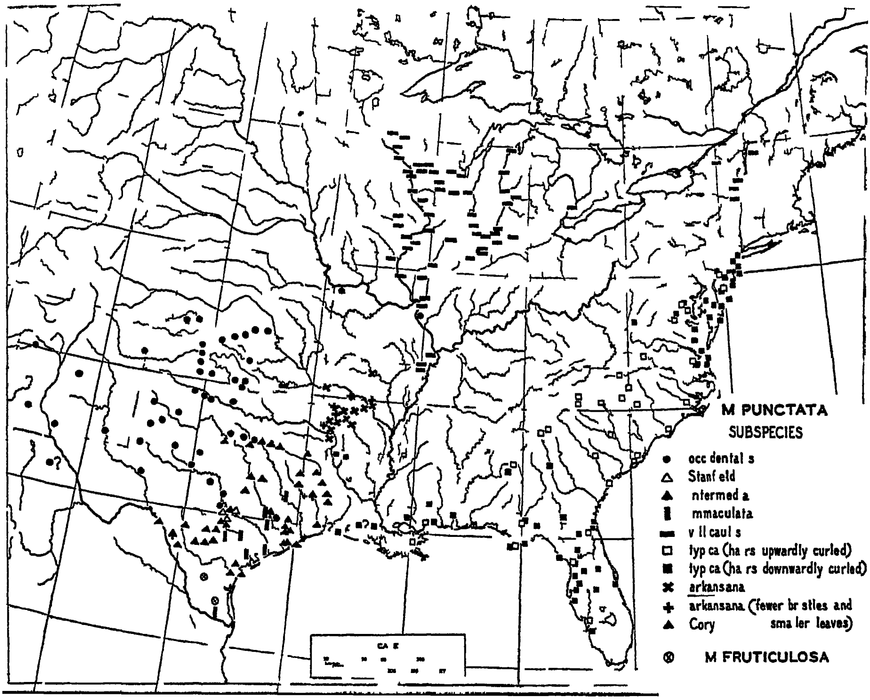

Fig 14 Distribution of the subspecies of *M. punctata* and of *M fruticulosa*

Perennial or biennial herbs 25–85 cm tall, their stems rarely unbranched, pubescent with short hairs which may be curled upward or downward, these frequently interspersed with longer spreading bristlelike hairs, largest leaves 30–78 mm long, commonly 40–50 mm, 6–17 mm wide, borne on petioles 6–20 mm long, commonly 8–15 mm, the internodes which they subtend 22–72 mm long, commonly about as long as the leaves, glabrous or puberulent on the upper surface, puberulent or pubescent with short hairs over the entire lower surface and with longer curled or straight hairs along the midvein and toward the base, calyces 6–9 mm long, teeth about 1 mm long, narrowly deltoid or somewhat acuminate, naked or occasionally with a few spreading hairs on the margins, the orifice glabrous or hispid with a few spreading hairs, corolla yellowish with purple spots, rarely white, the unexpanded portion of the tube 6–8 5 mm long, the throat 4 5–7 mm long, commonly 5–6 mm

Distribution (see fig 14) —Specimens with upwardly curled hairs along the stem

ALABAMA Lee County Auburn FLORIDA Duval Oakwood, Jacksonville, St Vincent Island Lee Punta Rassa (*J Standley* 267). Liberty Bluff Rock Landing on Apalachicola River, Pelican Key GEORGIA De Kalb Stone Mountain Gwinnett Yellow River near McGuires Mill Chatham Savannah Douglas Lithia Springs MARYLAND Anne Arundel Leon (*Shull* 257) Prince Georges Hyattsville NEW JERSEY Burlington New Lisbon, Camden, Clementon. Cumberland: Vineland. NORTH CAROLINA. Craven: New Bern; Gaston County. Guilford: High Point. Moore: Pinehurst. New Hanover: Fort Fisher, Wilmington. Polk: Columbus. Rowan: Salisbury. Rutherford: Chimney Rock (*Biltmore Herbarium* 653*a*). Stokes: Moores Springs. PENNSYLVANIA. Philadelphia: Philadelphia. SOUTH CAROLINA. Aiken: Aiken (*Ravenel*, Sept. 1886). Beaufort: Hardeeville. Charleston: Charleston (*Moldenke* 138). Georgetown: Georgetown. Richland: Columbia (*Eggert*, Aug. 1898). VIRGINIA. Campbell: Leesville to Lynch Station. Princess Anne: Cape Henry. Southampton: Franklin. Spotsylvania: Fredericksburg.

Specimens with downwardly curled hairs:

ALABAMA. Mobile County: Spring Hill, Mobile. Lee: Auburn. DELAWARE. Kent: Harrington. Sussex: Rehoboth, Ellendale. DISTRICT OF COLUMBIA. FLORIDA. Alachua: Gainesville. Brevard: Melbourne. Columbia: Lake City. Duval: Jacksonville (*Curtiss* 5228; 6706). Franklin: Apalachicola. Gadsden: River Junction (*Curtiss* 5984), Coral Key. Hernando: Brooksville, Citrus, St. Vincent Island. Hillsborough: Knights Station (*Blanton* 6743). Lee: Bonita Beach (*Moldenke* 9760). Leon: Tallahassee. Levy: Cedar Keys. Manatee: Palmetto (*Nash* 2456). Nassau: Fernandina. Orange: Clarcona. Pasco: St. Leo. Polk: Fort Meade. Sumter: Wildwood. GEORGIA. Bibb: Macon. Lowndes: Valdosta (*Harper* 1586). LOUISIANA. Bossier: Alden Bridge, Benton. Cameron: Creole, Lafayette (*Langlois*, September 1885). St. Tammany: Covington. Webster: Minden. MARYLAND. Prince Georges: Lanhan, Hyattsville, Riverdale (*Painter* 1224). Queen Annes: Chester, St. Marys. Wicomico: Quantico, Salisbury. Worcester: Ocean City. MISSISSIPPI. Forrest: Hattiesburg (*Tracy* 8753). Harrison: Biloxi (*Pollard* 1051), Long Beach. Jackson: Ocean Springs (*Tracy* 4895). NEW JERSEY. Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Middlesex, Monmouth, Ocean. NEW YORK. Staten Island. PENNSYLVANIA. Philadelphia. VIRGINIA. Bath: Millboro. Gloucester: Dutton. Northumberland: Walnut Point, Coan (*Tidestrom* 8196). Princess Anne: Cape Henry, Munden. Southampton: Franklin (*Heller* 1145). Warwick: Newport News.

11*b*. Subsp. **arkansana** subsp. nov.

Subsp. **arkansana** subsp. nov.; type collected by D. Demaree (no. 15590) in Arkansas at Cove Creek, near Magnet Cove, Hot Springs County (Univ. Calif., L. A.).

Perennial herbs 50–115 cm. tall, their stems simple or branched above, rarely from the base, pubescent with small, rather coarse downwardly curled hairs, and more or less hispid with spreading bristlelike hairs; largest leaves 41–98 mm. long, commonly 60–80 mm., 12–25 mm. wide, borne on petioles 8–27 mm. long, the internodes which they subtend 28–76 mm. long, usually less than the leaves, sparingly pubescent on the upper surface with short fine hairs, the lower surface sprinkled with longer spreading coarse hairs, especially along the veins; calyces 5.5–8 mm. long, commonly 6–7 mm., teeth about 1 mm. long, narrowly deltoid and somewhat acuminate, naked or with few spreading hairs on the margins, the orifice glabrous or hispid with a few spreading hairs; corolla yellowish with purple spots, the unexpanded portion of the throat 3.5–6 mm. long, commonly 5–6 mm.

Herbae perennes altitudine 50–115 cm. caulibus simplicibus vel superne (rarius in basi) ramosis utrimque pilis sat parvis et sat crassis decurvis pubescentibus et setis longioribus extensis plus minusve hispidis; foliorum laminis maximis 41–98 mm. longis, saepius 60–80 mm., 12–25 mm. latis, petiolis 8–27 mm. longis, internodiis oppositis 28–76 cm. longis, plerumque quam folia brevioribus, pagina superiore sparse pubescente, inferiore setis crassioribus praesertim ad venas conspersa; calycibus 5.5–8 mm. longis, saepius 6–7 mm., dentibus circiter 1 mm. longis, anguste deltoideis et parum acuminatis, vel nudis vel ad margines setis paucis conspersis, ore glabro vel sparse hispido; corollis flavidis purpureopunctatis, parte tubi dilatata 3.5–6 mm. longa, plerumque 5–6 mm.

Distribution (see fig. 14).—ARKANSAS. Clark County: Arkadelphia (*Demaree* 16126). Garland: Hot Springs (*Demaree* 15949), Crystal Springs (*Demaree* 15850). Hot Springs: Magnet Cove (*Demaree* 15590), Bismark (*Demaree* 16096). Hempstead: McNab (*E. J. Palmer* 12665), Fulton (*Bush* 973). Pike: Murfreesboro (*Demaree* 9363). Pulaski: Little

Rock. Saline: Benton (*Demaree* 8541). Sebastian: Fort Smith (*Bigelow* 1853). Stone: Sylamore (*Emig* 47). TEXAS. Bowie: Texarkana (*Heller and Heller* 4173).

The following have fewer bristles on the leaves and stems and smaller leaves and are transitional in some respects to subsp. *typica:*

ARKANSAS. Pike: Newhope (*Demaree* 9751). Sevier: Horatio (*Brinkley* 152), Mineral (*Brinkley* 373). Yell: Ola (*Demaree* 18228).

11*c*. Subsp. **villicaulis** Pennell

Subsp. **villicaulis** Pennell, Bull. Torr. Bot. Club 46: 186, 1919; type collected by Pennell (no. 6412) in Indiana near Clarks (N. Y. Bot. Gard.).

(?) *M. punctata* var. *lasiodonta* Gray, Syn. Fl. 2: 375, 1886; type collected in Texas by Drummond (Gray Herb.).

(?) *M. lasiodonta* Small, Fl. SE. U. S., ed. 1, 1038, 1337, 1903, with respect to name.

Perennial herbs 20–70 cm. tall, their stems simple or branched, densely hairy with spreading or downwardly curled rather coarse hairs; largest leaves 35–80 mm. long, commonly 50–70 mm., 7–20 mm. wide, commonly 10–15 mm., borne on petioles 5–20 mm. long, the internodes which they subtend 20–75 mm. long, commonly somewhat shorter than the leaf blades, upper leaf surface clearly but thinly pubescent with short appressed or spreading hairs, lower leaf surface tomentose with a dense coating of long curled hairs, often silvery; calyces 5–7.5 mm. long, the teeth about 1 mm. long, narrowly deltoid or somewhat acuminate, naked or with few spreading hairs on the margins, the orifice glabrous or hispid with few spreading hairs; corolla yellowish with purple spots, the unexpanded portion of the tube 5.5–7.5 mm. long, commonly 6–7 mm., the throat 3–5 mm. long.

Distribution (see fig. 14).—ILLINOIS. Cook (*Umbach* 11228), Henderson (*Patterson*, August 1871), Iroquois, Jo Daviess (*Gates* 2492), Lake, LaSalle, Madison, Mason, Morgan, Pike (*Davis* 4836), Rock Island, St. Clair counties. INDIANA. Jasper (*Deam* 39790), Kosciusco (*Deam* 1494), Lake (*Sherff* 1701, *Lansing* 2814, *Pennell* 6412, *Heller* 14267), Laporte (*Deam* 5223), Marshall (*Deam* 17942), Newton (*Deam* 18173), Porter (*Lansing* 3360), Starke (*Grimes* 2029) counties. IOWA. Benton: Vinton. Johnson: Iowa City. Muscatine: Moscow, West Liberty. MICHIGAN. Allegan (*Greenman* 2413), Berrien (*Lansing* 3267), Kent, Leelanau (*Ehlers* 4026), Macomb, Mason (*Chaney* 232), Muskegan, Oceana, St. Clair counties. MINNESOTA. Wabasha: Weaver (*Hotchkiss and Jones* 4169), Hokah (*Mearns* 842). MISSOURI. Clark, Dunklin, Marion, Scott counties. NEW JERSEY. Monmouth: Freehold (*G. L. Ames*, anno 1857). NEW YORK. Saratoga (*House* 21906), Schenectady, St. Lawrence (*Phelps* 818), Warren (*Benedict and Sorenson* 8284), Washington counties. OKLAHOMA. Bryan: Colberts Station. Grady: Chickasha. Pottawatomie: Tecumseh (*Barkley* 1354). WISCONSIN. Buffalo, Chippewa, Columbia (*H. H. Smith* 8022), Crawford, Dane (*Fassett* 2688), Dunn, Eau Claire, Grant, Green Lake, Jackson, Juneau (*Mearns* 842), La Crosse, Marquette, Milwaukee, Monroe, Pepin, Racine, Sauk, Trempealeau counties. VERMONT. Chittenden: Burlington.

11*d*. Subsp. **Stanfieldii** Epl.

Subsp. **Stanfieldii** Epl., Madrono 3: 25. 1935.

M. Stanfieldii Small, Fl. SE. U. S., ed. 1, 1038, 1903, type collected near San Marcos, Hays County, Texas, by Stanfield (N. Y. Bot. Gard.)

M. punctata var. *Stanfieldii* Cory, Rhodora 31: 407, 1936.

Perennial herbs 35–75 cm. tall, their stems pubescent with short spreading hairs in the upper parts so as to appear canescent, with downwardly curled hairs in the lower parts; largest leaves 62–92 mm. long, commonly 60–80 mm., 15–31 mm. wide, borne on petioles 20–26 mm. long, the internodes which they subtend 68–95 mm. long, commonly about as long as the leaf blades, puberulent on the upper surface with short fine hairs, evenly pubescent on the lower surface with longer curled hairs; calyces 7–10 mm. long, commonly 7–8 mm., pubescent with spreading hairs, the teeth about 1 mm. long, narrowly deltoid and somewhat acuminate, their margins densely hispid with long spreading coarse hairs, orifice densely bearded and apparently closed with coarse erect hairs; corollas yellowish with purple spots, the unexpanded portion of the tube 8–11.5 mm. long, the throat 4 mm. long.

Distribution (see fig. 14).—TEXAS. Hays: San Marcos (*Stanfield*). Travis: Austin (*Albers*, May 1935; *Parks* 14828, 14831).

11*e*. Subsp. **Coryi** subsp. nov.

Subsp. **Coryi** subsp. nov.; type collected by V. L. Cory (no. 14099) near Beeville, Texas (Univ. Calif., L. A.).

M. punctata subsp. *Stanfieldii* Epl., Madrono 3: 25, 1935, in part.

Perennial herbs 40–60 cm. tall, their stems pubescent with short fine downwardly curled hairs; largest leaves 40–70 mm. long, commonly 50–60 mm., 7–18 mm. wide, borne on petioles 10–23 mm. long, the internodes which they subtend 50–95 mm. long, usually longer than the subtending leaves, both surfaces evenly pubescent with short hairs; calyx tube 5–8 mm. long, the teeth narrowly deltoid and acuminate, naked or with a few spreading hairs on the margins, the orifice naked or hispid with a few spreading hairs; corollas (?) pink, nonpunctate, the unexpanded portion of the tube 5–8 mm. long, the throat 3.5–5 mm. long.

Herbae perennes altitudine 40–60 cm., caulibus utrimque pilis brevibus decurvis pubescentibus; foliorum laminis 40–70 mm. longis, magnam partem 50–60 mm., 7–18 mm. latis, paginis ambabus pilis brevibus pubescentibus; petiolis 10–23 mm. longis; calycum tubis 5–8 mm. longis; calycum dentibus anguste deltoideis acuminatis et ore subnudis; corollis (?) roseis, immaculatis, parte tubi dilatata 3.5–5 mm. longa cylindrata 5–8 mm. longa.

It is a pleasure to associate with this plant the name of Mr. V. L. Cory, whose exploration of Texas with Mr. H. B. Parks has added so abundantly to the material which is available for study.

Distribution (see fig. 14).—TEXAS. Angelina: Neches River (*Parks and Cory* 11953). Atascosa: Charlotte (*Shulz* 66). Bee: Beeville (*Cory* 14099). Bexar: San Antonio (*Cory*, May 1935), Senior (*Parks*, June 1937). Comal: New Braunfels (*Lindheimer* 1084). Dimmit: Carrizo Springs (*E. J. Palmer* 33749). Frio: Divot (*Cory* 14987). Harris: Houston (*Lindheimer* 152). Maverick: Eagle Pass (*Havard*). Nueces: Nuecestown (*Marlatt*, April 1896), Corpus Christi (*Heller* 1543). San Patricio: La Quinta (*Parks and Cory* 14487). Travis: Austin (*Tharp* 653). Uvalde: Uvalde (*Cory* 14987). Val Verde: Del Rio (*Cory* 15231). Washington: Brenham (*Albers*, August 1935). Wilson: Sutherland Springs (*Parks and Cory* 11769, 12380).

11*f*. Subsp. **intermedia** subsp. nov.

Subsp. **intermedia** subsp. nov.; type collected by V. A. Little (no. 14456) near Wills Point, in Van Zandt County, Texas (Univ. Calif., L. A.).

M. punctata subsp. *Stanfieldii* Epl., Madrono 3: 25, 1935, in part.

Perennial herbs 40–60 cm. tall or more, their stems pubescent with fine downwardly curled hairs; largest leaves 50–70 mm. long, commonly 60–70 mm., 11–20 mm. wide, borne on petioles 10–18 mm. long, the internodes which they subtend 35–90 mm. long, usually about equal to the leaf blade, both surfaces evenly pubescent with short hairs; calyx tube 5–8 mm. long, the teeth narrowly deltoid and acuminate, naked or with a few spreading hairs on the margins, the orifice naked or hispid with a few spreading hairs; corollas yellowish, purple dotted, the unexpanded portion of the tube 5–8 mm. long, the throat 3.5–5 mm. long.

Herbae perennes altitudine 40–60 cm. et ultra, caulibus pilis decurvis brevibus pubescentibus; foliorum laminis 50–70 mm. longis, magnam partem 60–70 mm. longis, 11–20 mm. latis, paginis ambabus pilis brevibus pubescentibus; petiolis 10–18 mm. longis; calycum tubis 5–8 mm. longis, dentibus anguste deltoideis, acuminatis et ore subnudis; corollis flavidis, purpureo punctatis, parte tubi dilatata 3.5–5 mm. longa, cylindrata 5–8 mm. longa.

Distribution (see fig. 14).—TEXAS. Anderson: Palestine (*Eggert*, June 1899). Bell: Temple. Brazoria: Columbia (*Bush* 1333, *E. J. Palmer* 6683). Comal: New Braunfels. Dallas: Dallas. Hardin: Silsbee. Harris: Houston (*Lindheimer* 152). Jefferson: Beaumont. Kaufman: Terrell. Limestone: Grosbeck (*E. J. Palmer* 7832). McLennon: Waco. Montgomery: Willis (*Parks* 14520). Newton: Newton (*Parks and Cory* 10917). Palo Pinto: Brazos. Rusk: (*Vincent* 100). Sabine: Yellow Pine. San Augustine: San Augustine. Tarrant: Fort Worth (*E. J. Palmer* 14232). Trinity: Trinity. Van Zandt: Willis Point.

11*g*. Subsp. **occidentalis** Epl.

Subsp. **occidentalis** Epl., Madrono 3: 25, 1935; type collected by Stevens (no. 3072) near Alva, Oklahoma (N. Y. Bot. Gard.).

M. punctata var. *occidentalis* Palmer and Steyermark, Ann. Mo. Bot. Gard. 22: 634, 1935.

Annual herbs 30–40 cm. tall, their stems simple or branched, pubescent with short fine downwardly curled hairs; largest leaves 23–53 mm. long, commonly 30–40 mm., 9–17 mm. wide, commonly 10–12 mm., borne on petioles 6–13 mm. long, the internodes which they subtend 23–85 mm. long, commonly about as long as the leaf blade, evenly pubescent with short fine hairs on both surfaces; calyx tube 4.5–7 mm. long, commonly 5–6 mm., pubescent with short fine hairs, teeth about 1 mm. long, broadly deltoid, nearly as broad as long and bearing a row of long silky spreading hairs; corollas white or pink, sometimes dotted with purple, the unexpanded portion of the tube 4.5–7 mm. long, the throat 3–4 mm. long.

Distribution (see fig. 14).—ILLINOIS. St. Clair: Prairie du Pont. (*Eggert*, August, 1897), introduced(?). KANSAS. Harper: Anthony. Seward: Arkalon (*Kellerman*, June 1888), Stevens, Sumner. MISSOURI. Jackson: Courtney (*Bush* 7679), introduced (?). NEW MEXICO. Dona Ana: Organ Mountains (*Vasey* 454, *Wooton* 424). Eddy: Carlsbad (*Wilkens* 2221). Grant: San Lorenzo. Torrance: Gran Quivira (*C. L. Hitchcock* et al. 4210). Quay: Nara Visa (*G. L. Fisher* 181). TEXAS. Andrews: Andrews (*Cory* 13810). Burnet: Fairland (*Pennell* 10474). Crane: Crane, Gillespie. Dickens: Spur. Garza: 16 miles E. of Post (*Cory* 13809). Hall: Estelline. Hardiman: Chillicothe (*Parks and Cory* 13374). Hemphill: Canadian (*E. J. Palmer* 14116). Hockley: Anton. Lampasas: Postoak woods east of Colorado River (*Wolff* 5113). Lipscomb: Lipscomb. Llano: Llano, Bauman's (*Parks and Cory* 6281). Lynn: O'Donnell. Mason: Freedonia (*Wolff* 5143). Mitchell: Colorado (*Tracy* 7990). Parker: Weatherford (*Tracy* 7992). Runnells: Ballinger (*Pennell* 10512), Tarrant. Taylor: Abilene. Waller: Hempstead (*E. Hall* 451). Wheeler: Mobeetie (*Tharp* 6277).

The following suggest a dwarfed form of this subspecies:

MEXICO. CHIHUAHUA. San Diego Hacienda (*Hartman* 730; unusually acuminate calyx teeth).

UNITED STATES. NEW MEXICO. Grant: San Lorenzo (*Wooton*, July 1906). Valencia: Inscription Rock (*Wooton*, August 1892).

11*h*. Subsp. **immaculata** Pennell

Subsp. **immaculata** Pennell, Bull. Torr. Bot. Club 46: 187, 1919; type collected by Pennell (no. 5494) near Aloe, Victoria County, Texas (N. Y. Bot. Gard.).

M. punctata subsp. *Stanfieldii* Epl., Madrono 3: 25, 1935, in part.

Perennial herbs 35–45 cm. tall, their stems pubescent with short fine hairs which usually curl downward but may curl upward; largest leaves 30–63 mm. long, commonly 30–50 mm., 3–7 mm. wide, borne on petioles 2–12 mm. long, the internodes which they subtend 12–40 mm. long, commonly shorter than the leaf blade, both surfaces evenly pubescent with short fine hairs; calyx tube 5–7.5 mm., pubescent with short fine hairs, the teeth 1 mm. long, narrowly deltoid and acuminate, bearing long silky or somewhat stiffish hairs; corolla pinkish (?), not spotted, the unexpanded portion of the tube 5–7 mm. long, the throat 3–5.5 mm. long.

Distribution (see fig. 14).—TEXAS. Austin: Cat Springs (*G. L. Fisher* 137), Gonzalez (*Bogusch* 1469), Hidalgo (*Clover* 829). Matagorda: Palacios (*G. L. Fisher* 3286). Victoria: Aloe (*Pennell* 5494). Washington: Brenham (*C. C. Albers* 11). Wilson: Sutherland Springs (*Parks* 16429, 14417, 15126; *Parks and Cory* 14415, 14428), "Carrizo Sand" (*Albers* 19), Calaveras (*Parks* 14879).

The following have the hairs upwardly curled:

Texas. Houston: Weldon (*Munson and Hopkins*). "Woods between Colorado and San Marcos" (*Wright*).

12. **M. fruticulosa** Epl.

M. fruticulosa Epl., Madrono 3: 26, 1935; type collected by Havard near Peña Station (U. S. Natl. Herb.).

Perennial herbs 30–40 cm. tall, their stems canescent with short fine downwardly curled hairs; largest leaves 18–37 mm. long, prevailing entire, sometimes toothed near the tip, canescent on both surfaces with short fine hairs; calyces 4–5 mm. long, pubescent with short fine spreading hairs, the teeth about 1 mm. in length, narrowly deltoid and acuminate, covered with long silky curled hairs, the orifice bearing long silky curled or spreading hairs; corolla pinkish (?), not dotted, the unexpanded portion of the tube 4.5–5.5 mm. long, the throat 3–4 mm. long.

This proposed species may prove to be confluent with *M. punctata* subsp. *immaculata*. Specimens collected on the ranch of George Frank, in Duval County, Texas (*Parks and Cory* 14758, 14760, 14762) vary from fairly typical *M. fruticulosa* (no. 14758) to a form scarcely distinguishable from *M. p.* subsp. *immaculata* (no. 14761).

Distribution (see fig. 14).—Texas. Duval: Peña Station (*Pringle, Nealley, Havard*), ranch of George Frank (*Parks and Cory* [?] 14761, 14760, 14762, 14758). Eleven miles NW. of Falfurrias (*Cory* 14759). Atascosa: Poteet (*Parks*).

Section *Aristatae*

Subsect. *Aristatae* Epl., Madrono 3: 26, 1935; type species *M. citriodora*. The relative distribution of the species of this subgenus is shown in figure 15.

Calyx teeth subulate to aristate, the veins 15.

13. **M. mexicana** Epl.

M. mexicana Epl., Madrono 3: 26, 1935; type collected by Garcia (no. 399) in Durango, Mexico, without specified locality (U. S. Natl. Herb.).

An herb, apparently annual, 35–40 cm. tall, its stems pubescent in the upper parts; median leaf blades lanceolate, 4–6 cm. long, 10–12 mm. wide, acute or acuminate, rounded and narrowed at the base to petioles 5–6 mm. long, their margins subentire, both surfaces glabrous and green, the uppermost or floral leaves longer and wider at the base and acuminate; verticils several, subtended by subfoliar, subrotund colored bracts which form an involucre; calyx tube 6.5–7 mm. long, glabrous, 15-veined, the teeth subulate, acute, 1.5 mm. long, villous; corolla whitish, purple dotted, the unexpanded portion of the tube about 7 mm. long, the throat 3.5–4 mm. long, the upper lip about 10 mm. long, the lower subequal; stamens shortly exserted; style hispidulous.

Distribution.—MEXICO. Durango. Without locality (*Garcia* 399).

14. **M. clinopodioides** Gray

M. clinopodioides Gray, Syn. Fl. N. Amer. 2: 375, 1878; a name based upon specimens collected in June, 1874, near Dallas, Texas, by Drummond, Wright, and Reverchon; Reverchon's specimens in the Gray Herbarium may be taken as the standard.

M. aristata Hook., Bot. Mag. pl. 3526, a name based upon a garden specimen grown from seed which had been collected in Texas by Drummond; erroneously referred to *M. aristata* Nutt. by Hooker.

M. citriodora var. *aristulata* Gray, Proc. Amer. Acad. 8: 369, 1873. Gray refers to the plate in Bot. Mag. 3526.

Annual, commonly 20–30 cm. tall, rarely as much as 55 cm., sparingly branched at the base or unbranched, its stems pubescent with downwardly curled hairs with which occasional longer bristles may be found; leaves mostly oblong, the largest 20–55 mm. long, commonly 35–40 mm., 6–15 mm. broad, rarely more, commonly 8–10 mm., the broadest part near the middle, both surfaces glabrous or puberulent, their margins remotely serrate or entire, borne on petioles 4–15 mm. long; glomerules 15–30 mm. broad, exclusive of the corollas, the outer bracts similar to the leaves but usually ending in a bristle, the inner ovate or elliptical, 3–7 mm. broad, abruptly acuminate to a stoutish spinose bristle, the midvein and usually 2 or even 4 to 6 lateral veins well developed and conspicuous, even costate, their inner surfaces glabrous, the outer evenly puberulent but not canescent, their margins regularly pectinate-ciliate with bristlelike hairs; calyx tube 8–9 mm., puberulent with small upwardly curled hairs, especially in the lower parts, usually more or less hirsute in the upper parts with bristlelike hairs, the orifice densely hirsute, the teeth subulate, stout, stiffish, usually red, 4–6 mm. long; corolla pink or nearly white, its tube 11–15 mm. long,

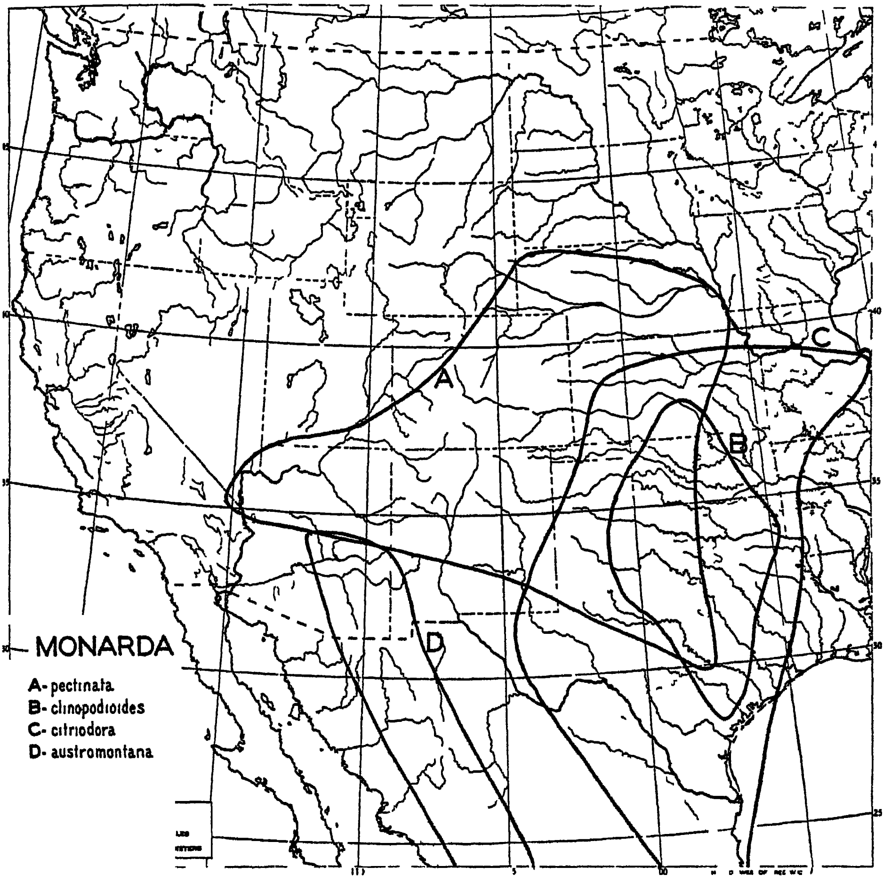

Fig. 15. Distribution of the species of subsection *Aristatae*. The extended range of *M. pectinata* into central Texas is meant to include the occurrence in Travis and Somervell counties of what is apparently that species. These specimens may have been introduced. Except for these records the ranges of *M. pectinata* and *M. citriodora* are almost distinct.

including the funnelform throat which is usually 4–5 mm long, the upper lip equal to or somewhat longer than the lower, equal to or somewhat shorter than the tube.

Distribution (see fig. 16).—KANSAS. Barber: Kiowa (*Rydberg and Imler* 635). Harper: Anthony, Harper (*Rydberg and Imler* 604). Kingman: Kingman, Pratt, Rice, Sumner.

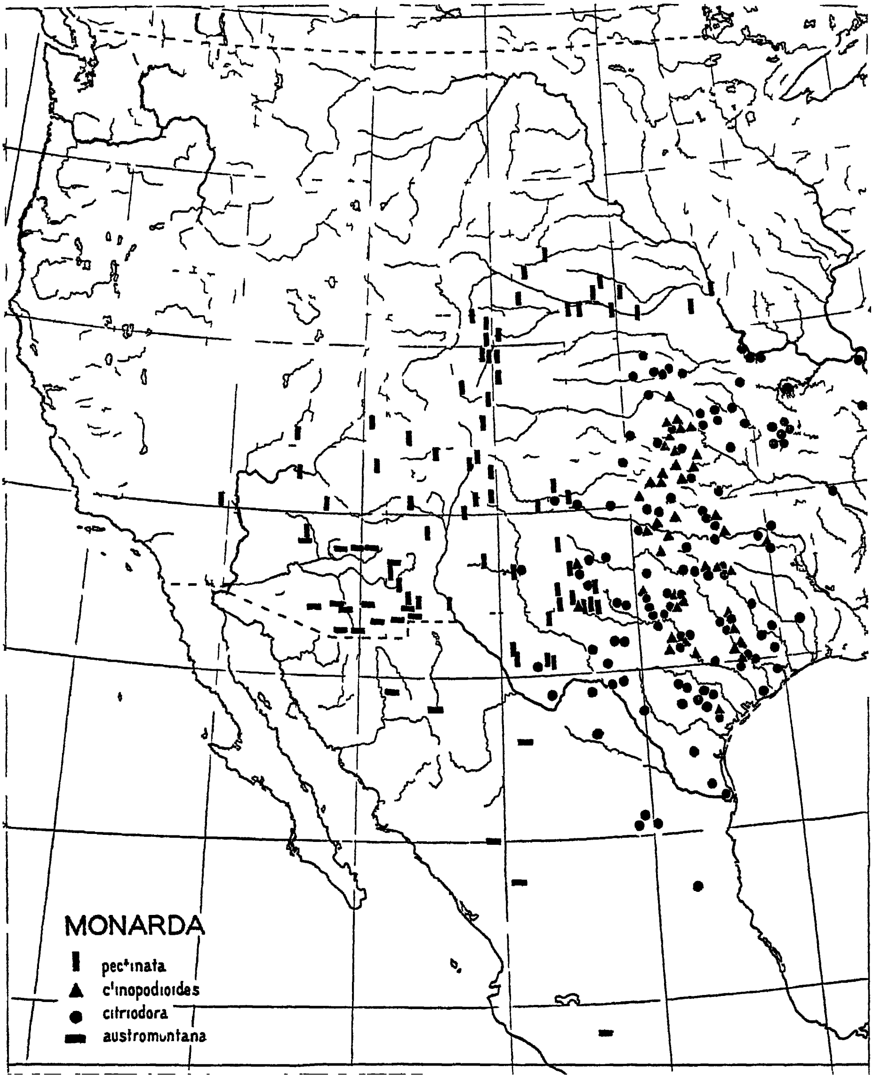

Fig. 16. Distribution of the species of Section *Aristatae* (except *M. mexicana*).

OKLAHOMA. Beckham: Sayre. Bryan: Colbert. Caddo: Chickasha (*Demaree* 13124). Cleveland: Norman (*Emig* 484; 604). Comanche: Fort Sill (*Clemens* 11758). Garfield: Enid (*McKelvey* 2505). Kingfisher: Huntsville. Logan: Guthrie. McClain: Blanchard (*Demaree* 137, 12871). Murray: Platt National Park (*Merrill and Hagan* 442). Oklahoma: Oklahoma City. Payne: Stillwater (*Stratton* 2628, *E. J. Palmer* 39448). Tillman: Frederick. Woods: Alva. TEXAS. Brazos: College Station. Burleson: Tunis (*G. L. Fisher* 3820). Burnet: Fairland. Comanche: Comanche (*Eggert*, 9. V. 1900). Dallas. Dallas (*Curtiss* 2039).

Eastland: Ranger (*Cory* 13152). Erath: Stephenville. Franklin: Robertson. Gillespie: Fredericksburg (*E. J. Palmer* 10046). Goliad: Goliad. Limestone: Grosbeck. Llano: Enchanted Rock (*Cory* 12955). Lubbock: Lubbock. Mason: 10 miles S. Mason (*Wolff* 5156). Martin: Stanton (*Eggert*, June 1900). Robertson: Franklin (*Cory* 21808). Tarrant: Fort Worth. Taylor: Abilene (*Eggert*, 7. VI. 1900). Buffalo Gap Hills (*Cory* 8756). Travis: Austin. Van Zandt: Wills Point. Washington: Quarry (*E. J. Palmer* 11710). Wichita: Wichita Falls. Wilbarger: Vernon. Yount: Olney (*Cory* 13154).

Although *M. clinopodioides* is readily distinguished ordinarily from *M. pectinata* by the length and stoutness of the calyx teeth and from *M. citriodora* by the bracts and the stouter calyx teeth, nevertheless frequent specimens occur which suggest in some measure both these species. Such specimens follow:

UTAH. Kane County: Three Lakes (*Eggleston* 10246). NEW MEXICO. Socorro County: Magdalena to Water Canyon (*Eggleston* 20226). OKLAHOMA. Beckham County: Sayre (*Pennell* 10583). Woods County: Alva (*Stevens* 654). TEXAS. Dawson County: near Lamesa (*Parks and Cory* 13816, 13817). Burnet County: Fairland (*Pennell* 10465, *Hill* 207, *Tharp* 743). Travis County: Austin (*Albers* 14076). Somervell County: Glen Rose (*Mulholland*).

15. **M. pectinata** Nutt.

M. pectinata Nutt., Jour. Acad. Philad. ser. 2. 1: 182, 1847, based upon plants collected by Gambel "near Santa Fe," New Mexico; no type is apparently preserved in the Nuttall herbarium, but an authentic specimen, thus labeled by Nuttall, is in the herbarium of the Royal Botanic Gardens at Kew; it is similar to specimens collected by Baker, Earle and Tracy (no. 614).

M. punctata var. *humilis* Torrey, in Sitgreaves Report 166, 1853; type collected by Woodhouse on the Zuni Reservation, New Mexico (N. Y. Bot. Gard.).

M. penicillata Gray, Proc. Am. Acad. 8: 369, 1873 (a blunder for *M. pectinata*).

M. Nuttallii A. Nels., Bot. Gaz. 31: 397, 1901, a name based upon several specimens collected in Colorado, of which no type was designated.

Annual, commonly 15–30 cm. tall, usually branched several times from the base, often spreading and globose, its stems pubescent with downwardly curled hairs with which occasional longer bristles may be found; leaves oblong-lanceolate or oblong, the largest 20–50 mm. long, prevailingly 25–35 mm. long, 6–12 mm. wide, rarely less, the broadest part near the middle, both surfaces glabrous or sparingly puberulent, their margins remotely serrate or subentire, borne on petioles 2–15 mm. long; glomerules 15–25 mm. broad, exclusive of the corollas, the outer bracts foliar, the inner oblong-elliptical, usually 2–7 mm. broad, acuminate to a spinose bristle, the midvein conspicuous, the lateral veins less so, usually 2, sometimes 4, the margins regularly pectinate-ciliate with bristlelike hairs, the outer surface nearly glabrous, the inner quite so; calyx tube 6–8 mm. long, puberulent with minute upwardly curled hairs or glabrous, very rarely with a few bristlelike hairs, the orifice hirsute, the teeth slender, not rigid, 2–3 mm. long, more or less hirsute with bristlelike hairs, often colored; corolla pink or nearly white, its tube 8–14 mm. long, including the funnelform throat which is usually 3–5 mm. long, the lips about equal, usually shorter than the tube.

Distribution (see fig. 16).—ARIZONA. Apache: Navajo Indian Reservation. Coconino: Grand Canyon (*Purpus* 8304), Flagstaff (*Hanson A*94). Yavapai: Dewey. CALIFORNIA. San Bernardino: Van Trigger in York Mountains. COLORADO. Arapahoe: Fort Logan. Boulder: Boulder. Chaffee. Denver: Denver (*Eastwood* 37). Douglas: Buffalo Creek (*Goodman* 2005). Fremont. Gilpin: Central City. Jefferson: Golden (*H. N. Patterson* 126), Morrison. La Plata: Durango. Larimer: Cherokee Park (*Nelson* 10001), Fort Collins. Montrose: Paradox. Sagauche: Crestone (*Rollins* 1305). Weld: Windsor. NEBRASKA. Banner: Prairie Dog Town. Buffalo: Kearney. Custer: Broken Bow, Anselmo, Calloway. Dawes: Belmont. Dawson: Gothenburg. Douglas: Omaha. Keith: Paxton, Ogalalla. Lancaster: Lincoln (*Burt* 10). McPherson: Tryon, Sheridan. Thomas: Thedford, Halsey. NEW MEXICO. Bernalillo: Sandia Mountains, Albuquerque. Catron: Beaverhead in Datil Forest (*Eggle-*

ston 20383), Luna (*Eggleston* 20236), Middle Fork of Gila River in Mogollon Mountains. Chaves: Roswell. Dona Ana: Organ Mountains (*Wooton,* May 1893). Grant: Mimbres River in Black Range. Lincoln: Gray. Moro: La Cueva. Quay: Naravisa (*Geo. Fisher* 180). Rio Arriba: Dulce. San Miguel: Las Vegas, Pecos, Rociada, Gallinas River. Santa Fe: Santa Fe, Glorieta. Socorro: Magdalena to Water Canyon (*Eggleston* 20226). Taos: Oja Caliente (*Wooton,* July 1904), Carson, Questa (*Hitchcock* et al. 4181), Barranca. Valencia: Bluewater. OKLAHOMA. Cleveland: Moore (*A. B. McReynolds* 10855). TEXAS. Andrews: Andrews. Brewster: Alpine (*O. E. Sperry* 113), Marathon. Culberson: Kent (*Earle and Tracy* 386). Dawson: Lamesa. Gaines. Garza: Post. Howard: Big Spring. Jeff Davis: Fort Davis, Mount Livermore in Davis Mountains. Lamb: Olton (*Cory* 13537). Lubbock: Littlefield, Lubbock (*Demaree* 7554). Martin: Stanton. Mitchell: Colorado. Oldham: Tascosa (*E. L. Reed* 3526). Potter: Ady. Somervell (*?*): Glen Rosa. Travis (*?*): Austin. Ward: Monshans. UTAH. Kane: east of Zion National Park. San Juan: Abajo Mountains, Bluff (*Maguire* et al. 5691).

16. M. austromontana Epl.

M. austromontana Epl., Madrono 3: 29, 1935; type collected by Pringle (no. 1355) on La Bufa Mountain near Cusihuiriachic, Chihuahua, Mexico (U. S. Natl. Herb.).

Annual, 25–70 cm. tall, its stems usually branched from the base or not at all, sometimes branching in the inflorescence, pubescent with small downwardly curled hairs with which occasional longer bristles may be found; leaves lanceolate or oblong-lanceolate, the largest 25–70 mm. long, usually 35–50 mm., 4–15 mm. wide, usually 7–10 mm., the broadest part 6–20 mm. above the base, both surfaces thinly and evenly puberulent, glabrate, their margins remotely serrate or subentire, sometimes sparingly ciliate near the base, borne on petioles 4–20 mm. long, these pubescent like the stems or bearing a few longer bristles as well; glomerules 12–22 mm. broad, excluding the corollas, the outer bracts leaflike but usually longer, usually strongly reflexed, the inner commonly 2–4 mm. wide, reflexed and disclosing the calyces, linear or linear-lanceolate, gradually attenuate into a spinose tip, only the midvein prominent, the inner surface minutely and densely canescent, often purplish, the outer surface puberulent, the margins thinly ciliate at least below the middle; calyx tube 8–9 mm., less often 10 mm. long, puberulent with minute upwardly curled hairs or nearly glabrous, the orifice densely bearded, the teeth aristate, 3–5 mm. long, puberulent, and more or less hirsute with bristlelike hairs; corolla white, or purplish tinged, dotted with purple, its tube commonly 8–12 mm., long, including the funnelform throat which is commonly 4–5 mm. long and nearly as wide, the upper lip apparently longer than the lower, shorter than the tube.

Distribution (see fig. 16).—ARIZONA. Apache: White Mountains (*Griffiths* 5404). Cochise: Chiricahua Mountains (*Blumer* 1382, *Eggleston* 10781). Huachuca Mountains (*Goodding* 353, 881, 1343; *Peebles, Harrison and Kearney* 3472). Gile: Sierra Ancha (*Harrison and Kearney* 8306). Graham: Mount Graham (*Harrison and Peebles* 9814; *Rothrock* 729). Navajo: Fort Apache. Pima: Mount Lemmon (*Peebles, Harrison, and Kearney* 2499), Santa Rosa Mountains, Santa Catalina Mountains (*Griffiths* 7096). Santa Cruz: Sunnyside to Elgin (*Kearney and Peebles* 13864), Sonoita (*Rothrock* 179), Patagonia (*Epling and Stewart*), Santa Rita Mountains (*Pringle* 591). Yavapai: Dewey (*W. W. Jones*). NEW MEXICO. Catron: San Francisco Mountains (*Hutchinson* 7833). Grant: Santa Rita, Black Range (*Hutchinson* 7835), Silver City, Burro Mountains. Hidalgo: Animas Valley (*Mearns* 2505). Lima: Lake Valley. Socorro: Mogollon Mountains (*Wooton*).

MEXICO. CHIHUAHUA. La Bufa Mountain above Cusihiuriachic (*Pringle* 1355), Sierra Charuco (*Gentry* 1753), Bolson de Mapimi (*Wislizenus* 633), San Lorenzo (*Wislizenus* 284), Memelichi, Rio Mayo (*Gentry* 2697), Colonia Garcia (*Townsend and Barber* 200; *Nelson* 6237), Madera (*Pennell* 19250), Sierra Gazachic (*Pennell* 18909). DURANGO. Cacaria (*Nelson* 4645), Barcelano near Purisima (*Pennell* 18596), Neveria near Durango (*Pennell* 18224), Santiago Papasquiaro (*E. Palmer* 457, 972), Culebra Mountains (*LeSueur* 887), Majalca (*Le Sueur*), San Juanito (*Knobloch* 5444). MICHOACAN. Between Patzcuaro and Uruapan (*Rountree* 195).

17. **M. citriodora** Cerv. ex Lagasca

M. citriodora Cerv. ex Lagasca, Gen. et Sp. Nov. 2, 1816, a name based upon garden specimens grown from seed which had been sent from Mexico two years previously by Cervantes. What are apparently authentic specimens, distributed by Pavon, are in the British Museum of Natural History and in the Boissier herbarium; none were among the Mociño and Sessé plants recently sent to this country for study. The Pavon specimens are very similar to specimens from Nuevo Leon and Tamaulipas, such as that of Pennell (no. 16767) near Monterrey, and Bartlett (no. 10156) near San Jose.

M. tenuiaristata Gray, a name not properly published; authentic specimens collected by Lindheimer (no. 497) are in the Gray Herbarium.

M. dispersa Small, Fl. SE. U. S., 1038, 1903; type collected by Bush (no. 122) in Missouri near Eagle Rock (N. Y. Bot. Gard.).

M. aristata Nutt., Trans. Amer. Phil. Soc. 5: 186, 1837; type collected in "Arkansa" by Nuttall (Brit. Mus.). While Volume 5 of the Transactions bears the date 1837, that portion containing Nuttall's paper, which had been read in 1834, was actually distributed prior to 1836.

Annual, (? or sometimes biennial) commonly 30–60 cm. tall, branching chiefly in the inflorescence, or unbranched, seldom branched at the base, pubescent with small downwardly curled hairs; leaves lanceolate or oblong, the largest commonly 30–60 mm. long, rarely as short as 15 mm. or as long as 80 mm., prevailingly 8–12 mm. wide, rarely as narrow as 4 mm., or as broad as 16 mm., the broadest part toward the middle of the blade, both surfaces thinly and evenly puberulent, glabrate, their margins remotely serrate or subentire, usually ciliate near the base with longer bristles, borne on petioles 2–30 mm. long, commonly about 6–12 mm., pubescent like the stems and usually bearing longer bristles as well; glomerules 15–35 mm. broad, exclusive of the corollas, the outer bracts subfoliar and spreading, less often reflexed, the inner oblong, infrequently lanceolate, commonly 6–9 mm. broad, less often 4–5 mm., abruptly acuminate to a spinose bristle 2–5 mm., long, usually reflexed from the middle only, thus enclosing the calyces in a bowl-like involucre, their inner surfaces densely canescent with minute hairs, often purple, the outer surface pubescent, the margins more or less ciliate at least below the middle, only the midvein prominent; calyx tube 6–13 mm. long, commonly 8–10 mm., puberulent with minute upwardly curled hairs, orifice densely bearded, the teeth aristate, 2–7 mm. long, puberulent, and more or less hirsute with bristlelike hairs; corolla white or pink, dotted with purple, its tube 7–19 mm. long, commonly 10–15 mm. long, including the funnelform throat which is commonly 3–7 mm. long, the upper lip about equal to the lower lip, both shorter than the tube.

M. citriodora and *M. austromontana* are distinguishable chiefly by the nature of the bracts. In all other respects they are very similar. Throughout most of their range they are readily distinguishable. In northeastern Mexico, however, forms occur which, although most like *M. citriodora* as it occurs farther north, nevertheless approach *M. austromontana* in the nature of the bracts. Save for this possible exception *M. austromontana* presents comparatively little variation. *M. citriodora* on the other hand, although usually recognizable without difficulty by reason of the bracts, is nevertheless much more variable, chiefly in respect to the color of the pubescence on the upper surface of the bracts and in their width. A form with broad purple bracts occurs from Texas northward and is the more common form found outside of Texas. In southern Texas and in Mexico the bracts are usually narrower and whitish, and the whole plant is less robust. This is the sort of plant originally described by Cervantes. However, all intermediate forms appear, and it is impossible to discern any geographic correlations, at least on the basis of herbarium material. However, there appears to be a fairly well-defined but unnamed form in southern Texas, in which the whole plant is diminished. The leaves range from about 20–35 mm. in length and 5–10 mm. in breadth. The calyx tube is mostly 6–7 mm. long. The unexpanded portion of the corolla tube is 6–7 mm. long, the throat 2–4 mm. The calyx teeth are about 2 mm. long.

Distribution (see fig. 16).—Arkansas. Benton: Sulphur Springs (*E. J. Palmer* 3793). Carroll: (*Bush* 14505). Pulaski: Little Rock (*Coville* 39). Kansas. Anderson. Barber: Kiowa. Butler. Clark: Englewood (*Rydberg and Imler* 829). Cowley. Elk. Ellis: Hays (*Gates* 16922). Ellsworth: Wilson. Greenwood. Labette: Montana, Edna. Leavenworth: Leavenworth. Lincoln: Liberal (*Hitchcock* 406). Osborne: Osborne City (*Shear* 113), Alton. Pawnee: Larned. Russell: (*Kellerman*), Saline, Woodson, Wyandotte, counties. Missouri. Barry: Eagle Rock (*E. J. Palmer* 6329; *Bush* 122). Greene: Willard (*Standley* 9625). Iron: Annapolis. Jackson. Jasper: Carthage (*E. J. Palmer* 3800). Hickory: Weaubleau (*E. J. Palmer* 36788). St. Louis: Allenton. Stone: James River (*E. J. Palmer* 5864). New Mexico. Chaves: Roswell. Oklahoma. Alfalfa: Aline. Caddo: Fort Cobb to Fort Arbuckle (*E. Palmer* 235). Cleveland: Norman (*Demaree* 12787). Garvin: Pauls Valley (*Demaree* 12905). Greer: Granite (*Stevens* 1025). Hughes: Holdenville. Johnston: Mannsville (*Griffith* 3497). Kiowa: Saddle Mountain (*Demaree* 13069). McCurtain: Idabel. Murray: Davis (*Emig* 620), Platt National Park. Rogers: Catoosa (*Bush* 458). Woods: Alva (*Stevens* 3073). Texas. Anderson (*Tharp* 741), Archer, Armstrong, Austin (*Pennell* 10274), Bee (*Cory* 14118), Bexar, Brazos, Brewster (*E. J. Palmer* 34247, 34248), Burnet (*Tharp* 743), Cameron, Coke (*E. J. Palmer* 30496), Coleman, Comal (*Lindheimer* 1083), Comanche, Concho, Crockett, Crosby, Dallas (*Curtiss* 2039), Dickens, Duval, Eastland (*Parks* 12568), Edwards (*Gates* 19154), Erath (*E. J. Palmer* 14195), Fayette, Foard, Garza (*Ruth* 1406), Grayson, Guadalupe, Harris, Hidalgo, Houston, Irion, Jeff Davis (*Cory* 9503), Kaufman, Kerr (*Heller* 1761), Kimble, Lamar, Limestone (*E. J. Palmer* 7831), Lipscomb, Live Oak (*Cory* 14765), Lubbock, McLennon, Matagorda (*E. J. Palmer* 9645), Medina (*Cory* 12639), Mitchell, Montgomery, Nolan, Oldham, Palo Pinto, Parker (*Tracy*), Randall, Runnels, San Augustine, Shackelford, Sutton (*Cory* 15184), Tarrant (*Ruth* 1025), Taylor, Tom Green (*Cory* 15310), Travis (*Pennell* 10447), Uvalde, Val Verde (*Parks* 4005), Walker, Waller (*E. Hall* 451), Washington, Williamson, Wilson (*Cory* 15127) counties. Utah. Kane: Three Lakes (*Eggleston* 10246).

MEXICO. Coahuila. Sierra del Carmen (*Wynd and Mueller* 524), Muzquiz (*Wynd and Mueller* 436), Saltillo (*E. Palmer* 361), San Lorenzo (*E. Palmer* 1082). Nuevo Leon. Monterrey (*Pennell* 16767, *Lundell* 5716, *Mueller and Mueller* 139, *Fr. Arsene* 6206, *Dodge* 155, *Gregg*), Galeana (*Mueller and Mueller* 869, *Pennell* 16984). Tamaulipas. San Jose (*Bartlett* 10156), Cerro Zamora (*Bartlett* 11063).

The diminished form is represented by the following specimens:

Texas. Cameron: Brownsville (*Tharp* 1196; *Lewton* 154; *Benke* 6428; *Runyon* 244), Los Fresnos (*Wolff* 2368). Hidalgo: near San Juan (*Clover* 5). La Salle: Fowlerton (*Cory* 14996). Nueces: Corpus Christi (*Pennell* 10323; *Parks* 14489, 14490), Agua Dulce (*Parks* 14493). San Patricio: near Tynan (*Cory* 14109, 14118). Wilson: near Floresville (*Cory* 15127).

The following apparently represent introductions:

Alabama. Uniontown, Tuscaloosa, Mobile. Georgia. Athens. Illinois. Chicago. Louisiana. New Orleans. Michigan. Alamo, Brighton Park. Mississippi. A. & M. College, Starksville. Tennessee. Nashville.

Dubious names based chiefly on garden specimens, many of which were undoubtedly garden hybrids, have appeared as follows:

1. *M. affinis* Link, Enum. Plant. 1: 9, 1821.
2. *M. albiflora* Morr., Belg. Hortic. 1: 40, 1851. (? *M. fistulosa*).

3. *M. altissima* Willd., Enum. Hort. Berol. 1: 33, 1809, with villous pubescence but somewhat the habit of *M. media.*
4. *M. amplexicaulis* Fisch. ex Morr., Belg. Hortic. 1: 41, 1851.
5. *M. barbata* Wender., Ind. Sem. Hort. Marb. (1828), and in Flora XII. (1829) I Erg. 28; (? *M. Bradburiana*).
6. *M. Beckii* Eat., Mann. Bot. ed. V. 298, 1829; (*Blephilia*).
7. *M. caerulea* Hort. ex Benth., Lab. Gen. and Sp. 317, 1833.
8. *M. chinensis* Osbeck, Dagbok. Ostind. Resa. 240, 1757; (?).
9. *M. clinopodifolia* Linn. ex Jacks., Ind. Sem. Herb. 106, 1912; (? *M. clinopodia*).
10. *M. commutata* Wender., Ind. Sem. Hort. Marb. (1828), and in Flora XII. (1829) I Erg. 28; (? *M. fistulosa*).
11. *M. contorta* Morr., Belg. Hortic. 1: 37, t. 6, 1851.
12. *M. cristata* Hort. ex Benth., Lab. Gen. and Sp. 317, 1833; (? *M. fistulosa*).
13. *M. didynama* Stokes, Bot. Mat. Med. 1: 44, 1812; (*M. didyma*).
14. *M. dubia* Hort. ex Benth., Lab. Gen. and Sp. 317, 1833; (? *M. fistulosa*).
15. *M. elongata* A. Dietr., Sp. Pl. 1: 356, 1831; (? *M. fistulosa*).
16. *M. glabra* Lam., Encycl. IV, 256, 1797; (? *M. fistulosa*)—a glabrate form.
17. *M. gracilis* Pursh, Fl. Amer. Sept. 1: 17, 1814; based upon plants seen living in the mountains of South Carolina and Virginia; a specimen of the Lyon herbarium is also referred to; no specimens were found at Kew, nor in the herbarium of the Academy of Natural Sciences at Philadelphia. (? *Pycnanthemum*).
18. *M. hirsuta* Pursh, Fl. Amer. Sept. 1: 17, 1814; no specimens are preserved; presumably *Blephilia hirsuta.*
19. *M. hybrida* Wender., Ind. Sem. Hort. Marb. (1828), and in Flora XII. (1829) I Erg. 28; (? *M. fistulosa* or a hybrid).
20. *M. involucrata* Wender., *loc. cit.;* (? *M. clinopodia*).
21. *M. lilacina* Wender., *loc. cit.;* (? *M. fistulosa* or a hybrid).
22. *M. longifolia* Lam., Encycl. IV, 255, 1797; ? a hybrid of *M. mollis.*
23. *M. oblongata* Soland., in Ait., Hort. Kew, ed. 1, 36, 1789; (? *M. fistulosa*).
24. *M. purpurascens* Wender., Ind. Sem. Hort. Marb. (1828), and in Flora XII. (1829) I Erg. 28; (? *M. didyma*).
25. *M. purpurea* Lam., Encycl. IV, 256, 1797; (? *M. media* Willd.).
26. *M. rigida* Raf., Med. Fl. 2: 37, 1830; (? *M. Bradburiana*).
27. *M. rugosa* Soland., in Ait., Hort. Kew, ed. 1, 36, 1789; (? *M. clinopodia*).
28. *M. undulata* Tausch ex Reichb., Hort. Bot. II: 31, t. 181, 1827–1830.
29. *M. variana* Bartr., Prodr. Fl. Philad., I: 36, 1815, ex Benth. Lab. Gen. and Sp. 726, 1835; (? *M. fistulosa*).
30. *M. violacea* Desf., Tabl. ed. II: 66, 1815; (? *M. fistulosa*).
31. *M. virginalis* Hort. ex Vilm., Fl. Pl. Torre, ed. III: 709, 1870 (apparently a white-flowered form of *M. fistulosa*).
32. *Pycnanthemum Monardella* Mich., Fl. Bor. Amer. 2: 8 Pl., 34, 1803; based upon a specimen collected in the mountains of North Carolina; the specimen in the Michaux herbarium, evidently the same one which was illustrated, is a slender form of *M. fistulosa* in which the calyces are abnormal, as pointed out by Gray (Amer. Jour. Sci. Ser. I., 42: 45, 1842). It is doubtful whether any normal flowers were produced.

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BY

ELIZABETH GRANT AND CARL EPLING

THE GENUS PYCNANTHEMUM, as defined herein, consists of 21 species. Of these, *P. californicum,* as its name implies, is found only in California, and is geographically isolated from the remainder of the genus; it is also morphologically stable and distinct. A second species, *P. nudum,* found in northern Florida and the adjacent regions, is peripheral, although not completely isolated geographically; it is morphologically constant, however, and readily recognized. The remaining 19 species occupy the same or overlapping territories throughout the eastern United States, chiefly east of the Mississippi River. The specific limits of these species are by no means clear, and there is no one of these presumed species which does not vary in such a way as to suggest another similar species in part, or which does not present intermediate forms that appear to be hybrids with some other species. It is clearly impossible to analyze this maze of interconnecting forms by the herbarium method alone. All that can be done is to point out what seem to be the nuclei of gene complexes and to indicate in some small measure the variation which exists around and between these nuclei. At best, such an endeavor is a beginning which may serve as a point of orientation and departure for future, more detailed analysis. Because of the tentative nature of the present work, the authors have sought to avoid, as much as possible, the publication of new names until it is known more clearly what such names may mean. Only four have been proposed and of these, two are new combinations. Furthermore, the morphological evidence itself has suggested a treatment somewhat different from the usual separation into species and varieties or subspecies. For while it is true that most of the species present a network of interconnecting forms, two poorly defined species groups or phylads can be perceived in addition to *P. californicum* and *P. nudum.* These phylads (fig. 1) may each be a polyploid complex which is connected with the other through *P. clinopodioides,* and connected to some degree with the remaining species, either through hybrids or localized polyploids. Vegetative reproduction may have been instrumental in preserving or extending some of these forms, such as *P. Beadlei.* The investigation of such local variants is a fertile field for future work and is necessary for a further understanding of the genus.

ACKNOWLEDGMENTS

In the course of this study, approximately six thousand herbarium specimens of *Pycnanthemum* were critically compared and studied. These plants were obtained on loan from the herbaria of the following institutions: the Royal Botanic Gardens at Kew, the New York Botanical Garden, the Missouri Botanical Garden, the Field Museum, the Academy of Natural Sciences at Philadelphia, the Gray Herbarium, the United States National Herbarium, Stanford University, Kansas State College, the California Academy of Sciences, the University of California (Berkeley and Los Angeles), West Virginia Univer-

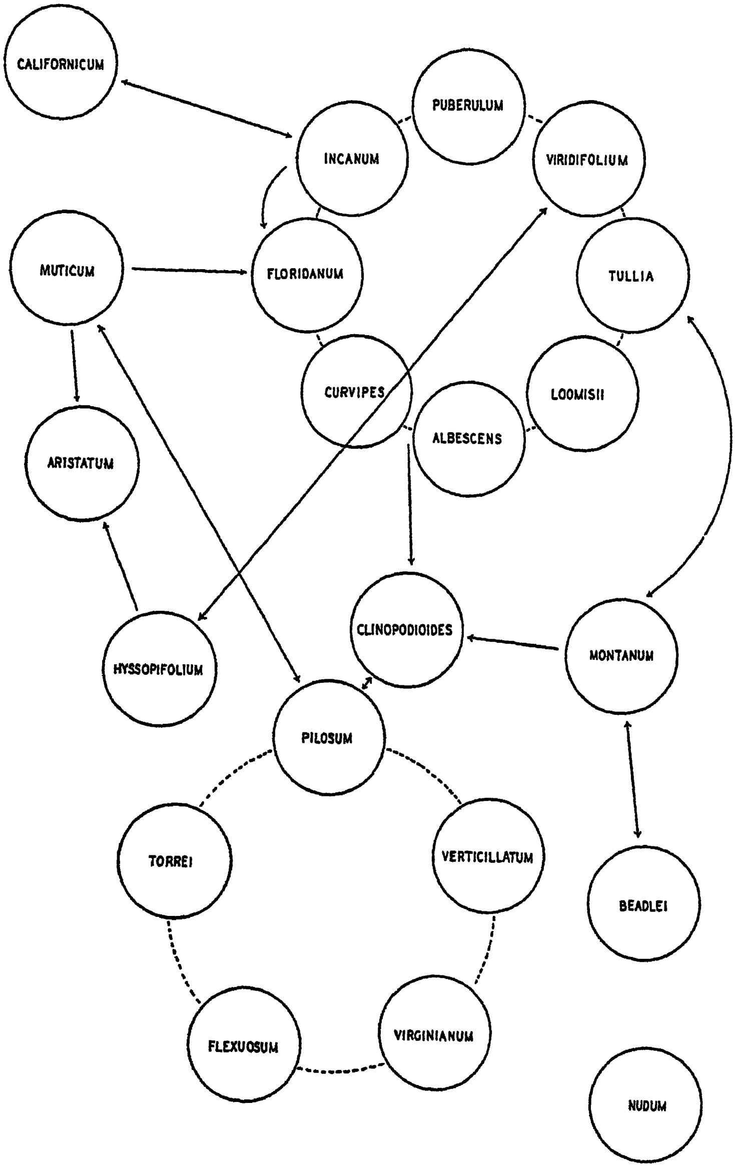


Fig. 1. A tentative arrangement of species of *Pycnanthemum* which suggests their possible interrelationships. There appear to be two principal centers of variation, illustrated by the circles which are joined by broken lines. *P. californicum*, widely separated geographically, is probably allied to one of these complexes. Four secondary centers may be seen in *P. muticum*, *P. hyssopifolium*, *P. montanum*, and *P. nudum*. The last named is not immediately connected with the other centers. The other three are variously connected by intermediate forms as indicated by the unbroken lines.

sity, Columbia University, the University of Michigan, the University of Wisconsin, the University of Göttingen, the University of Tennessee, and the private herbarium of C. C. Deam. In addition to these collections various types and other historical specimens have been examined at the British Museum of

Natural History, the National Herbarium in Paris, the Botanical Institute in Berlin, the Linnaean Herbarium and the Herbarium of the University of Oxford. Grateful acknowledgment is made to the curators of these herbaria.

THE INCANUM PHYLAD

The first phylad, which is also the largest and most intricate, centers around *P. incanum.* It includes *P. curvipes, P. albescens, P. floridanum, P. Loomisii, P. incanum, P. viridifolium, P. Tullia,* and *P. puberulum.* These species are characterized by petiolate, serrate leaves, by conspicuously two-lipped calyces, except in 2 species, and by the jointed bristles on the bracts and calyx teeth, except in 3 species. The glomerules are always loose, their branches usually being visible. Each of these species is similar in one or more traits to other members of the group, but they are not clearly defined and may be differentiated only upon consideration of several characteristics in combination. Occasional specimens occur which appear to be compounded of characteristics of two or more of the species recognized. Either the phylad is a racial complex formed of a number of incipient species and speciation is incomplete, or the specific distinctions are obscured by the presence of allopolyploids or hybrids or both. The herbarium method can do no more than indicate the principal modes of variation; until these are genetically understood, it has seemed preferable to assign specific rank to each of the principal variants of the complex, particularly since five of the eight thus recognized have already been given specific epithets. Some of these have at various times been considered as of "varietal" rank: *P. incanum* var. *albescens, P. pycnanthemoides* var. *viridifolium, P. incanum* var. *Loomisii.* Yet, if morphology and distribution be considered, it seems more consistent that *P. Loomisii,* for example, be considered a variety of *P. pycnanthemoides* (*Tullia*) rather than of *P. incanum;* or even more logical perhaps, that all of the entities of this phylad be "reduced" to varietal or subspecific rank. Each appears to be of roughly equivalent weight and suggests an independent origin from a common complex. In other words, there appears to be no end to the plausible combinations which one might propose on morphological grounds alone. Until other than morphological evidence is at hand to aid in interpreting this complex, we prefer to disturb the existing system as little as possible.

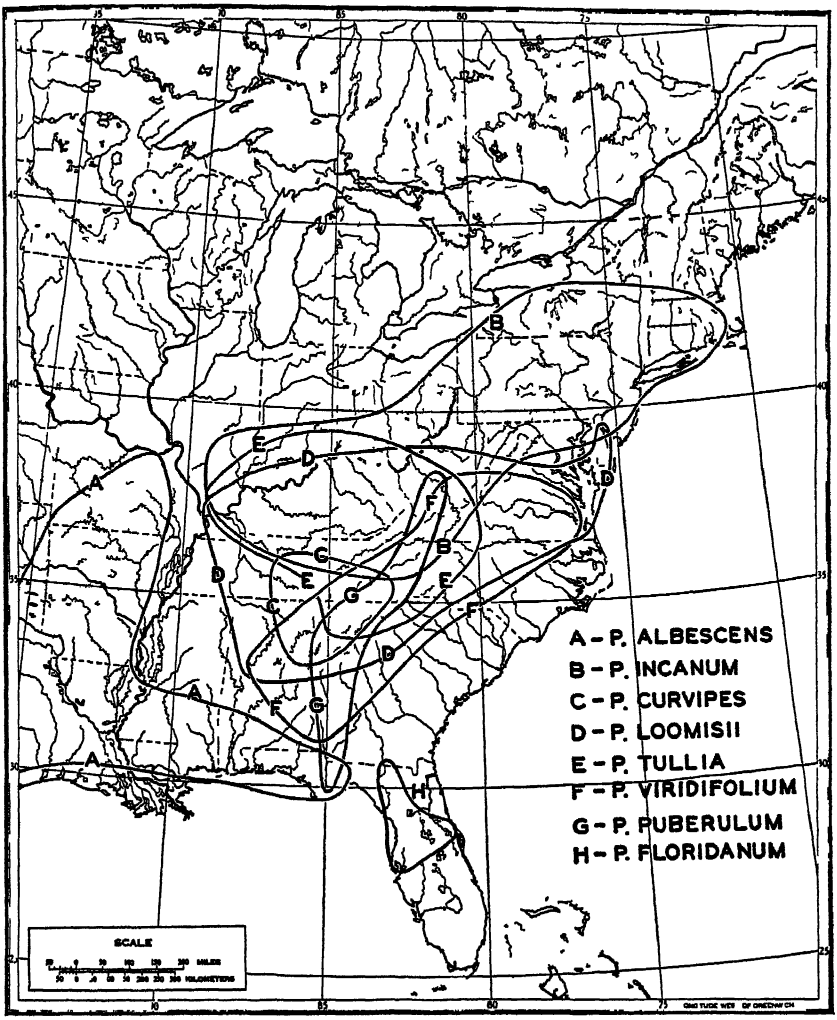
P. albescens is found in Oklahoma, Texas, Missouri, Arkansas, Mississippi, Louisiana, Alabama, and western Florida. Only in Florida does it seem to overlap with other species. Unlike most of the members of the group, the calyces and bracts are incanous with short curled hairs only; there are none of the longer-jointed bristles. In this respect it is like *P. curvipes* and *P. floridanum.* In southern Texas and along the Gulf coast the pubescence of the stem consists mostly of short curled hairs. Farther north, however, longer spreading hairs appear on the leaves and stems. Such forms, suggestive of *P. incanum,* occur in Oklahoma and Arkansas, and in Missouri, where this longer haired form has been most frequently collected. The short-haired form seems to be more uniform and the leaves tend to be smaller and narrower. The longer-haired forms are somewhat more suggestive of *P. incanum* in vegetative habit. That both pubescence types may occur in the same locality is shown by collections made by Demaree (no. 14145) at Hot Springs, Arkansas, and by Heller (no. 4093) at Texarkana, Arkansas. The pubescence of *P. albescens* is generally less dense than that of *P. incanum* or of *P. curvipes.* The leaves are consistently smaller than those of *P. incanum* and a little smaller than those of *P. curvipes;* they are generally narrowly ovate and rather sharp. The calyx teeth are mostly obtuse and often cupped, about 1–1.5 mm. long. The form of the calyces merges with that of *P. curvipes* (*Curtiss* 5981, Florida) and of *P. incanum.* A collection from Waynesboro, Mississippi (*Pollard* 1247*a*) approaches *P. incanum* in calyx teeth, but otherwise resembles *P. albescens* and lies within its range.

P. curvipes occurs in Alabama, Georgia, Tennessee, and North Carolina. The pubescence on the stems and leaves is similar to the short, curled type of *P. albescens.* In Tennessee and occasionally in Georgia a few longer hairs may be present on the lower parts of the stem. The leaves have quite dense, curled hairs, or rarely bear a few longer hairs on the midvein of the median leaves. There are no long, jointed bristles on the calyx teeth nor on the bracts. In this respect it is similar to *P. albescens* and *P. floridanum* and unlike the other species of this group. The calyx teeth are acuminate, like those of *P. incanum,* but are short, .5–1.2 mm. long, deltoid, and subequal. The posterior three are but lightly joined. In habit the plants are more like *P. Loomisii* than the other species of the group.

The pubescence of *P. Loomisii* consists of the two types that occur on *P. albescens.* The curled hairs on the leaves are smaller and closer than those of *P. albescens* and the lower surface of the leaves is more silvery. The leaves are narrower, becoming elliptic. The calyx teeth are similar to those of *P. Tullia* and are longer than those of *P. albescens* or of *P. incanum.* Moreover, the lower pair usually extends beyond the upper which is usually not true of either of these species.

P. incanum is the northernmost species of this group and is separated from the other members in all but its southern and western area. It is densely hairy with both long and short hairs. In some specimens, however, the longer hairs are wanting. The curled hairs are notably longer than those of any other members of the group. The leaf blades are somewhat rounded at the base and vary from ovate or ovate-lanceolate to oblong. This oblong narrow-leaved form is found chiefly in Maryland, Pennsylvania, eastern New York, Massachusetts, and Connecticut. The calyces show more than usual variation on the same plant. The calyx teeth are ordinarily connate to the middle or less, the lower teeth being 1–1.5 mm. long. Specimens from Parker, Illinois (*Benke* 5260), Nashville, Indiana (*Clarke* 34), Mifflin, Indiana (*Deam* 52608), and Willow Valley, Indiana (*Deam* 17196) have the habit of *P. albescens* or of *P. Tullia* but seem closer to *P. incanum* in pubescence and calyces.

The stems of *P. Tullia* are pubescent with both short and long hairs. The leaves are broadly lanceolate or ovate, and in contrast to those of *P. incanum,* are generally narrowed at the base. The calyx teeth are about 2 mm. long, and the upper ones are usually ⅓–½ as long as the lower pair. The upper teeth usually extend beyond the lower. This species is fairly widespread and constant in southern Indiana. It is less constant in the Appalachian Mountains.



Map 1. Distribution of the species of the *incanum* phylad as abstracted from map 4.

The pubescence of *P. viridifolium* is of a different order from that found in the preceding species. The stems are thinly hirsute with somewhat coarser spreading hairs of varied length. The short, curled type of pubescence is entirely wanting. There is a greater tendency for the leaves to be rounded at the base than in *P. Tullia* and they are hirsute with spreading hairs. The calyx teeth vary from 1.5–3 mm. long. The lower calyx teeth are usually shorter than the upper.

Still another type of pubescence is that found on the stems and leaf veins of *P. puberulum.* It consists of rather sparse downwardly curled hairs which are coarser and of a different habit than the curled hairs previously referred to. The leaves are rounded at the base. The calyx teeth are not quite as long as those of *P. Tullia,* and the lower are usually longer than the upper.

P. floridanum (see maps 1, 4) may be of hybrid origin between a species of this group, such as *P. albescens,* and *P. muticum.* It is suggestive of both.

THE VIRGINIANUM PHYLAD

The second or narrow-leaved phylad, which centers about *P. virginianum,* is composed of five species: *P. pilosum, P. Torrei, P. verticillatum, P. virginianum,* and *P. flexuosum* (see maps 2, 7–11). The general habit of these species is very different from that of the preceding group, in that the leaves are all linear or narrowly lanceolate, and usually entire. They are rarely as wide as two centimeters. The stems are glabrous (in one species), or variously pubescent. The short, curled type of pubescence found on the stems in the *incanum* group is entirely lacking or is found only on the floral leaves. The glomerules are smaller and compact. The calyx teeth are fused only slightly at the base, and vary from deltoid to lanceolate. Long, jointed bristles are entirely absent.

P. virginianum and *P. verticillatum* are similar in habit, and have the same type of calyx teeth. They can be distinguished from one another chiefly by the pubescent bracts of the second species, and the differences in pubescence of the stem. The pubescence of *P. virginianum* is confined chiefly to the angles of the stem and is of three types: long spreading pili, short upwardly curled hairs, and long upwardly appressed pili. The principal tendency for the pubescence on the stem of *P. verticillatum* is to turn downward, but it may be spreading, or directed upward. It is not confined to the angles but occurs evenly over the surface.

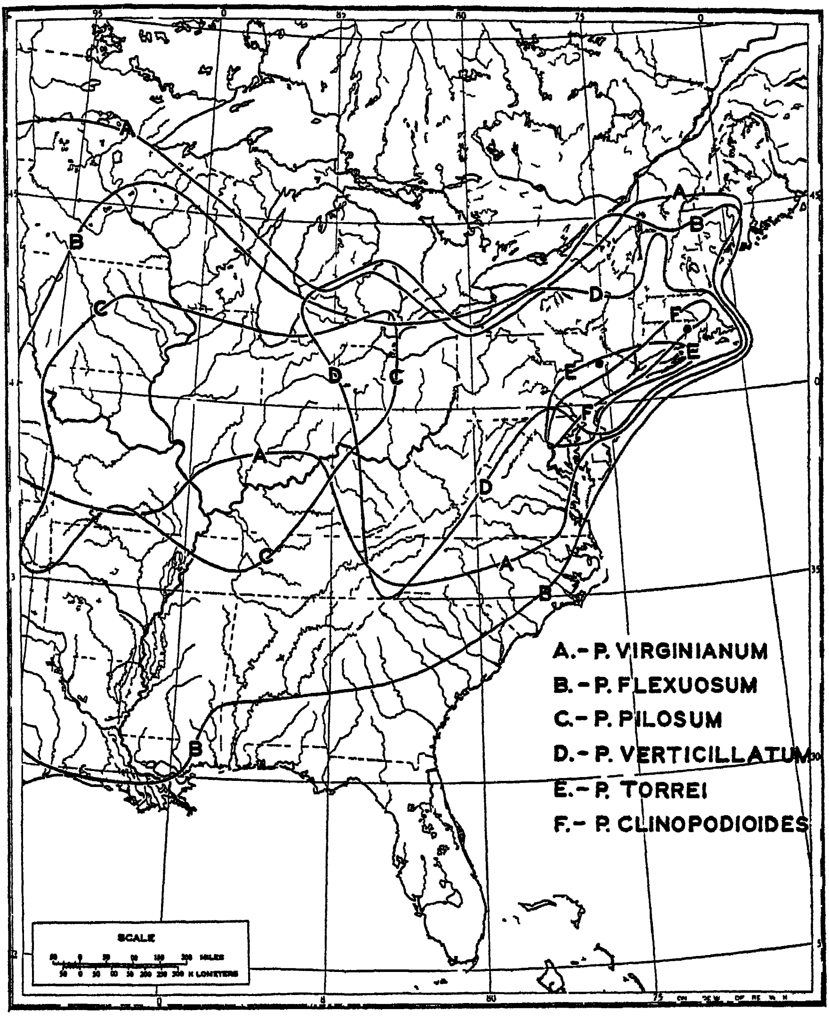
The stems of *P. flexuosum* are prevailingly glabrous but rarely have a few short upwardly curled hairs of the type found in *P. virginianum.* A few specimens occur with wider leaves and a type of venation which approaches that of *P. virginianum.* These forms are found chiefly along the Ohio River in Indiana (see map 4). Although the texture of the leaves is similar in both species, the differences in venation described below appear to be fairly constant.

The two remaining species, *P. Torrei* and *P. pilosum,* are somewhat variable, but are not easily confused with other species; the former has lanceolate calyx teeth which are actually longer and very narrow leaves; and the latter has pilose stems and shaggy calyces.

The two phylads which have been described above appear to be connected by *P. clinopodioides* (see maps 2, 6) in the sense that, while that species has narrow leaves with the texture and habit of those of the *virginianum* phylad, it has the loose glomerules, the bristling hairs on the calyces, and calyces which are more suggestive of the *incanum* phylad. However, it may have been derived from some narrow-leaved form and *P. montanum.*

There seem to have been still other exchanges of gene complexes. *P. flori-*

danum has the habit of the *incanum* phylad (*P. albescens*) to which it has been usually assigned. However, its leaves are nearly glabrous and in texture and venation strongly suggest the leaves of *P. muticum*. The deltoid, nearly equal calyx teeth are also suggestive of some previous intermixture. Furthermore, *P. aristatum* might very well have had its origin in *P. muticum*, or a similar form, and *P. hyssopifolium*. It is intermediate in morphology. As will be seen from the notes which follow, *P. muticum* appears to have formed sporadic hybrids or, possibly with *P. pilosum*, localized polyploids. *P. dubium* may have been derived from *P. montanum* and *P. Tullia*, as suggested by Gray, either as a hybrid or as a polyploid. *P. Beadlei* suggests a similar relationship with *P. montanum* and some other entity. Finally, an entity has been found



Map 2. Distribution of the species of the *virginianum* phylad as abstracted from maps 7–11.

in southwestern Virginia which may be of similar origin from *P. Tullia* and *P. hyssopifolium.* As stated above, only *P. nudum* and *P. californicum* present no transitional forms with other species.

No mention has been made of the corollas or essential organs. By reason of their small size, no readily useful distinctions can be observed in boiled specimens. The corollas are apparently white, often dotted with purple or pinkish. They are approximately of the same conformation throughout. The stamens are apparently aborted in some forms.

GENUS **Pycnanthemum**

Pycnanthemum Michx., Fl. Bor. Amer. 2: 7, t. 33, 1803, based upon four species: *P. incanum, aristatum, montanum,* and *Monardella.* Of these *P. incanum* has been proposed as the standard or lectotype by M. L. Green. The generic name *Pycnanthemum* has been conserved against *Furera* Adans., Fam. II, 193, 1763 and against *Koellia* Moench, Meth. 407, 1794.

Brachystemon Michx., Fl. Bor. Amer. 2: 5, tt. 31, 32, 1803, based upon three species: *B. verticillatum, muticum,* and *virginicum. B. muticum* is suggested as the type species, since it is perhaps more readily recognized and stable than *B. verticillatum.* It is to be preferred to *B. virginicum,* the eldest known species, because of the involved nomenclature of that species.

Tullia Leavenworth in Amer. Jour. Sci. Ser. I, 20: 343, t. 5, 1830, based upon *T. pycnanthemoides* Leavenw.

Perennial herbs 30–150 cm. tall, commonly about 80 cm., their stems simple, or with lateral branches in the axils of the upper leaves, the inflorescence simple or branching; median internodes mostly about equal to subtending leaves, two-thirds as long, or rarely twice as long; pubescence of various types, less frequently none; leaf blades simple, linear, lanceolate, elliptic, oval, ovate-lanceolate, or ovate, the median and largest 1–10 cm. long, .2–4.5 cm. broad, glabrous or pubescent, entire or serrate, essentially sessile, the longest petioles rarely exceeding 15 mm.; glomerules compact, or loose with the branches apparent, pedunculate in the axils of the upper leaves, terminal, 1–5 on a common peduncle, solitary or disposed in a corymb, usually subtended by a pair of leaflike outer bracts, these canescent to nearly glabrous, sometimes ciliate or tipped with longer bristles; calyces nearly glabrous, pubescent, or canescent, 3–9 mm. long, commonly 4–6 mm., the teeth deltoid to long acuminate, or stoutly aristate, nearly equal and similar or irregular as a result of partial fusion of the posterior three to form two lips, variously pubescent and sometimes tipped with longer bristles; corolla tube enlarged upward, 2.2–7.5 mm. long, the upper lip 1.5–4 mm. tall; stamens four, the lower pair somewhat longer, all thrust outward from the corolla and usually exceeding it, rarely nonfunctional and contained within the tube; nutlets smooth or tipped with short hairs.

Distribution.—Eastern North America, north of Mexico, and chiefly east of the Mississippi River and south of the St. Lawrence; one species in California.

KEY TO THE SPECIES*

A. Median petioles 3–12 mm. long (shorter in *P. Beadlei,* rarely less in *P. montanum*); glomerules usually loose, the branches apparent, and pedunculate in the axils of the uppermost leaves (except *P. montanum* and *P. Beadlei*); calyx tube or teeth and bracts variously short pubescent (sometimes glabrous) and usually bearing in addition elongate jointed bristles 1–3 mm. long; calyx teeth and inner bracts never aristate.

B. Glomerules compact, appearing sessile, their branches not apparent, calyces bearing longer jointed bristles on the upper parts, glabrous or nearly so, for the rest; inner bracts essentially glabrous except for jointed bristles on their margins; leaves ovate-lanceolate or oblong.

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* Because of the morphological overlapping of most of these entities and the occurrence of many intermediates, this key cannot be completely definitive.

C. Outer bracts (except for bristles) and stems quite glabrous; median petioles as much as 8 mm. long; leaves tending to be narrowed toward the base. 11. **P. montanum**

CC. Outer bracts and subtending leaves canescent with small curled hairs, at least at the base; median petioles usually less than 3 mm. long; leaves thickish, rounded at the base and even clasping the stem, subentire .... 10. **P. Beadlei**

BB. Glomerules loose, the branches apparent, pedunculate in the axils of the upper leaves; calyx teeth and bracts usually with long jointed bristles.

C. Leaves narrowly lanceolate, 1–2.5 cm. broad, entire or shallowly serrate; bracts inconspicuously canescent with short hairs, stems pubescent with short, usually curled hairs and fewer spreading ones; calyx teeth with a few long jointed bristles (see note to *P. dubium*) .... 12. **P. clinopodioides**

CC. Leaves ovate-lanceolate to ovate, the median 1.3–5 cm. broad, mostly serrate; bracts canescent with short curled hairs; stem pubescence variable; calyx teeth with or without long jointed bristles.

D. Calyx teeth and bracts usually without long jointed bristles.

E. Calyx teeth deltoid, acute, .5–1.2 mm. long, the upper joined only at the base, approximately equal to the lower; pubescence, at least of the upper parts of the stem and floral leaves, consisting of short curled hairs only.

F. Median leaves practically glabrous, resembling those of *P. muticum* in texture, acuminate, the longest petioles 3–5 mm. long; calyx teeth narrowly deltoid and acute, strict, at least twice as long as broad; plants of east central Florida .... 5. **P. floridanum**

FF. Median leaves finely pubescent on both surfaces, the lower minutely and and densely canescent, acute or obtuse but hardly acuminate, resembling those of *P. albescens* in texture, the longest petioles usually 8–15 mm. long, rarely 5 mm.; calyx teeth deltoid, as broad as long and abruptly acuminate at the tip, the tip commonly recurved; plants of the Southern Appalachian Mountains in North Carolina, Tennessee, Georgia and Alabama 4. **P. curvipes**

EE. Calyx teeth ovate, blunt and cupped, 1–1.5 mm. long, the upper cut usually less than ½ the length of the lip; pubescence consisting of either short curled hairs or with longer spreading hairs as well; plants found east of the Mississippi River from Missouri to Louisiana and Texas and along the Gulf to western Florida .... 3. **P. albescens**

DD. Calyx teeth and bracts usually tipped with long jointed bristles or the latter pectinate.

E. Lower calyx teeth usually about 2 mm. long.

F. Pubescence of stems consisting of spreading rather coarse hairs only, the leaves hirsute with straight hairs; plants of the Appalachian Mountains from Virginia and West Virginia to Alabama .... 8. **P. viridifolium**

FF. Pubescence of stems hardly canescent, consisting of short curled hairs only, such hairs minute and close on stems and leaves; lower calyx teeth usually longer than the upper; an anomalous form ranging from southwestern North Carolina southward to western Florida... 9. **P. puberulum**

FFF. Pubescence of stems canescent, consisting of both short curled hairs and longer spreading ones, the latter few, sometimes wanting, the former minute.

G. Lower calyx teeth usually longer than the upper; plants occurring in most of the states south of the Ohio River and east of the Mississippi 6. **P. Loomisii**

GG. Lower calyx teeth usually shorter than the upper; plants of similar but more restricted range .... 7. **P. Tullia**

EE. Lower calyx teeth usually 1.5 mm. long; plants found particularly from Virginia northward and eastward but ranging to Illinois, Tennessee and North Carolina; the curled pubescence is coarser than in the two preceding 2. **P. incanum**

AA. Median petioles rarely over 3 mm. long; leaves mostly entire, ovate or oval if serrate; glomerules mostly compact and sessile, the branches not apparent; calyces variously pubescent, but never tipped with jointed bristles (if so, see above).

B. Calyx teeth 1.3–5 mm. long, these and the inner bracts tapering to a rigid point; calyces costate, minutely puberulent, appearing glabrous to the naked eye.

C. Calyx teeth 1.3–2.2 mm. long; median leaves ovate, 2.5–6 cm. long; lateral veins 5–7 pairs..19. **P. aristatum**

CC. Calyx teeth 2.3–5 mm. long; median leaves narrowly oblong to elliptic or oval, commonly 2–4 cm. long; lateral veins 3–4 pairs...........20. **P. hyssopifolium**

BB. Calyx teeth .7–1.5 mm. long, frequently tapering but the point not rigid or at most subspinose; calyces equally pubescent with short hairs, or ciliolate on the margins of the teeth.

C. Stems and leaves entirely glabrous, the former rarely bearing short hairs curled upward on the angles of the stem (see also *P. virginianum*).

D. Calyx teeth subspinose and sharp, hirtellous, about 1.5 mm. long; leaves linear, 1.5–5.5 mm. broad, lateral veins usually 2 pairs arising near the base of the leaf ....17. **P. flexuosum**

DD. Calyx teeth about 1 mm. long, narrowly deltoid, not at all spinose, ciliate, the tube glabrous and punctate; leaves ovate, 5–15 mm. broad; lateral veins 3–4 pairs, equally distributed................................21. **P. nudum**

CC. Stems and usually the leaves clearly pubescent with short or long hairs.

D. Median leaves not more than 2½–3 times as long as broad, serrate, sometimes shallowly, ovate or ovate-lanceolate, rarely lanceolate, mostly over 1.5 cm. broad.

E. Calyces canescent with curled hairs, particularly above, commonly 5 mm. long; calyx teeth woolly; median leaves 5.5–8.5 by 2–5 cm., the upper surfaces softly hirtellous............................1. **P. californicum**

EE. Calyces closely pubescent in the upper parts, commonly 3.5 mm. long; calyx teeth hirtellous on the margins; median leaves 2–8 by 1–3.5 cm., the upper surfaces glabrous and tending to shine, veiny..........18. **P. muticum**

DD. Median leaves more than 2½ times as long as broad, entire or sometimes shallowly serrate, lanceolate, or broadly lanceolate, mostly less than 1.5 cm. broad.

E. Calyx teeth lanceolate, 1–1.5 mm. long; stem sparingly pubescent; leaves 5–12 mm. broad; plants found from Connecticut to Maryland (see also note on *P. leptodon*)..................................14. **P. Torrei**

EE. Calyx teeth narrowly deltoid, but sometimes tapering, .7–1 mm. long; leaves 6–20 mm. broad.

F. Stems pubescent on the angles only, the hairs variable; upper bracts and leaves glabrous or rarely puberulent; lateral veins usually 4 pairs; plants found from the New England States to Nebraska and Kansas 16. **P. virginianum**

FF. Stems pubescent on all sides; upper bracts and leaves canescent, at least toward the base.

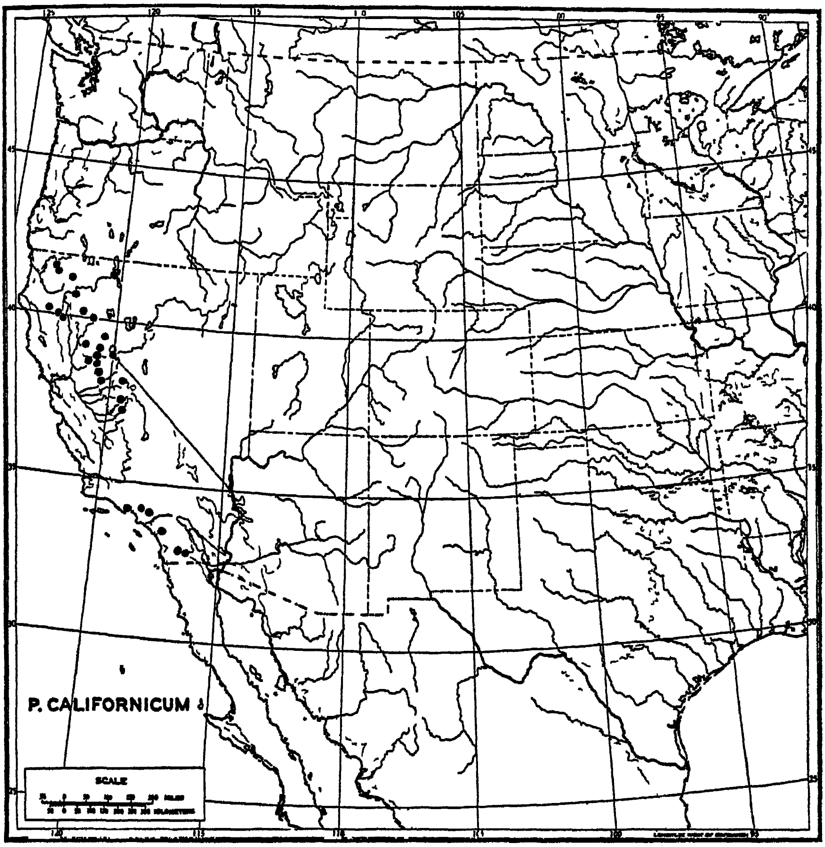
G. Stems thinly pubescent; lower surface of leaves pubescent chiefly on veins; lateral veins 4–5 pairs with usually weaker supernumerary veins; calyces with short pubescence in upper parts; plants found from Michigan and North Carolina eastward.......15. **P. verticillatum**

GG. Stems thickly pilose with spreading hairs; lower surface of leaves evenly pubescent with spreading hairs; lateral veins usually 4 pairs; calyces shaggy-canescent with short hairs; plants found from Ohio and Michigan westward, rarely eastward...........13. **P. pilosum**

1. **P. californicum** Torrey

P. californicum Torrey ex Dur., Jour. Acad. Philad. Ser. II, 3: 99, 1855, based upon a specimen collected near Nevada City, Nevada County, California, by Henry Pratten; the probable type is in the herbarium of the Academy of Natural Sciences at Philadelphia.

P. californicum var. *glabellum* Gray, Syn. Fl. N. Amer. 2: 355, 1878, based upon specimens collected in California on the "Upper Sacramento" by Bigelow and Brewer; the type sheet is in the Gray Herbarium, bearing both specimens. Brewer's specimen was collected on the "Upper Sacramento," Bigelow's near Mokelumne Hill.



Map. 3. Distribution of *P. californicum.*

Koellia californica Kuntze, Rev. Gen. 2: 520, 1891.

Perennial herbs as much as a meter tall, commonly 60–70 cm., their stems either simple or branched in the inflorescence, the median internodes commonly about two-thirds the length of the subtending leaves, the lower nodes glabrate or becoming so, the upper canescent with dense, usually somewhat curled hairs which are directed downward; leaf blades ovate or ovate-lanceolate, the largest usually median or near the lower branches, 4–9 cm. long, usually about 7 cm., 1.5–4.5 cm. broad, the lowest glabrate or becoming so, the upper canescent with dense curled hairs, all save those of the inflorescence sharply denticulate, all essentially sessile, the longest petioles usually not more than 3 mm.; glomerules canescent, 2–5, forming an interrupted leafy spike, these solitary or disposed in a narrow corymb, each subtended by a pair of subfoliar canescent bracts, the inner bracts more or less plumose; calyces canescent with curled hairs, 3.5–6 mm. long, commonly about 5 mm., the teeth narrowly deltoid, mucronate, the posterior three connate at the base, about two-thirds as long as the anterior pair which are commonly about 1.5 mm. long, or subequal; corolla tube pubescent within the throat, gradually enlarged upward, 4–6.5 mm. long, the upper lip commonly 3–4 mm. tall.

This species has a wide distribution, yet it is fairly constant. There is some variation in leaf shape, from ovate-lanceolate to almost lanceolate. A few specimens appear glabrous to the naked eye and were given the name *P. californicum* var. *glabellum* by Gray. Except for the pubescence, these specimens are like *P. californicum*.

The plant is distributed from Siskiyou and Modoc counties southward to Mariposa County; in southern California it occurs in the San Bernardino, San Jacinto, Santa Monica (in chaparral), San Gabriel, Santa Ana, Laguna, and Palomar mountains. It is usually an associate of the yellow-pine forest.

Distribution.—CALIFORNIA. Amador, Calaveras, El Dorado, Fresno, Los Angeles, Mariposa, Modoc, Nevada, Orange, Placer, Plumas, Riverside, Sacramento, San Bernardino, San Diego, Shasta, Sierra, Siskiyou, Tehama, Trinity, Tuolumne, and Yuba counties.

2. **P. incanum** Michx.

P. incanum Michx., Fl. Bor. Amer. 2: 7, 1803.

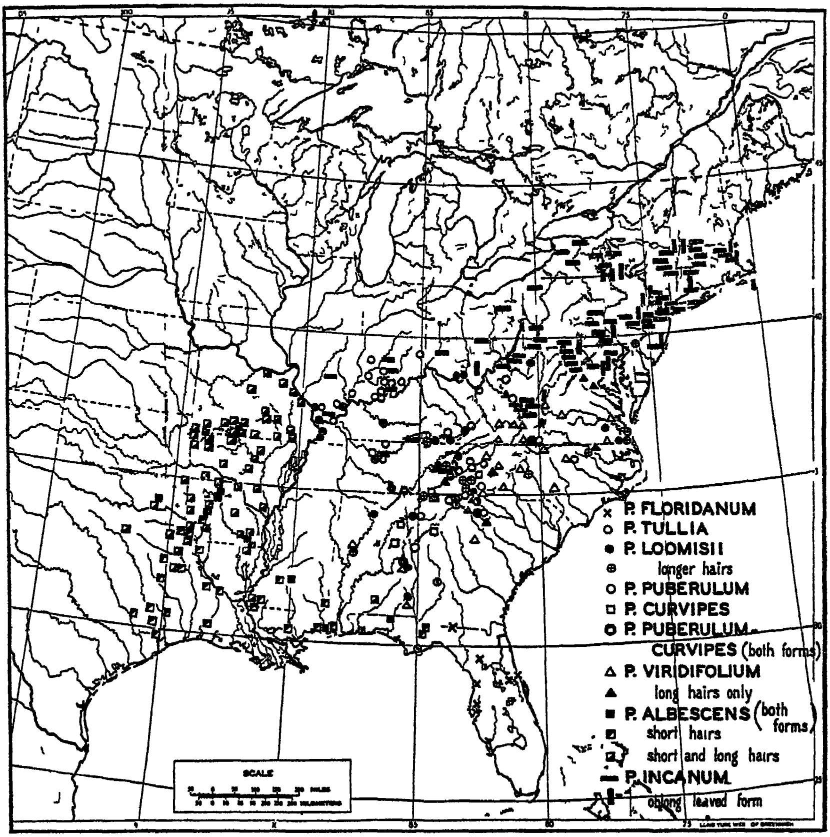
Clinopodium incanum L., Sp. 588, 1753; a Kalm plant present at the first enumeration (Dayton Jackson, Index to the Linnaean Herbarium. Proc. Linn. Soc. 1911–1912, suppl.) may be taken as the standard; it is conspecific with the plants of the Plukenet, Dillen, and Morison herbaria, as well as with a plant collected by Clayton but not cited by Linnaeus.

Koellia incana Kuntze, Rev. Gen. 520, 1891.

Perennial herbs rarely as much as 150 cm. tall, commonly about 80 cm., their stems loosely branched in the upper part, the median internodes about two-thirds as long as the subtending leaves, or about equal, densely pubescent with both short curled hairs and a few longer spreading ones, or rarely with only short curled hairs; leaf blades ovate-lanceolate, less often lanceolate, somewhat rounded at the base, lighter beneath, serrate, the median usually largest, 4.5–11 cm. long, commonly about 7 cm., 1.5–5.5 cm. broad, the upper surface glabrous or with a few spreading hairs, the lower canescent with both types of hairs, the longer particularly on the veins, both surfaces of the upper and floral leaves pubescent and incanous, median petioles usually about 8 mm. long; glomerules canescent, loose, their branches apparent, terminal, a few disposed in irregular corymbs, the bracts of the involucre canescent and bearing a few longer jointed bristles; calyces canescent throughout, 3.5–6 mm. long, commonly 5 mm., the posterior three teeth connate at the base, usually about two-thirds to one-half as long as the anterior pair, which are commonly 1–1.5 mm. long, acuminate, tipped with a few long, jointed bristles; corolla tube gradually enlarged upward, 3–4.5 mm. long, the upper lip 2.5–3.5 mm. tall.

The leaf blades may be either ovate or ovate-lanceolate, or less frequently oblong, and somewhat rounded at the base. The oblong-leaved form is found chiefly in Maryland, eastern Pennsylvania, eastern New York, Connecticut, and Massachusetts. The calyces show appreciable variation, and diverse forms may occur on the same plant.

Distribution (of typical form).—CONNECTICUT. Hartford, New Haven, and New London counties. DISTRICT OF COLUMBIA. ILLINOIS. Johnson and Marion counties. INDIANA. Brown, Crawford, and Martin counties. Kentucky. Clinton County. Maryland. Allegany County. Massachusetts. Bristol, Dukes, Franklin, Hampden, Hampshire, Middlesex, Norfolk, and Plymouth counties. New Jersey. Atlantic, Bergen, Essex, Hunterdon, Middlesex, Morris, Sussex, and Union counties. New York. Albany, Bronx, Dutchess, Erie, Livingston, Monroe, Nassau, New York, Ontario, Orange, Saratoga, Schuyler, Suffolk, Tompkins, Ulster, Westchester, and Yates counties. North Carolina. Northampton and Swain counties. Ohio. Coshocton, Greene, and Portage counties. Pennsylvania. Adams, Allegheny, Bedford, Berks, Berkshire, Blair, Bucks, Center, Columbia, Cumberland, Delaware, Dauphin, Erie, Fayette, Huntingdon, Lancaster, Lebanon, Lehigh, Luzerne, Mifflin, Monroe, Northampton, Northumberland, Philadelphia, Pike, Schuylkill, Susquehanna, Westmoreland, and York counties. Tennessee. Knox and Robertson counties. Vermont. Bennington and Windham counties. Virginia. Augusta, Fairfax, Fauquier, Highland and Shenandoah counties. West Virginia. Cocke, Doddridge, Fayette, Greenbrier, Hampshire, Hardy, Monongalia, Monroe, Pendleton, Pocahontas, Raleigh, Ritchie, Summers, and Wirt counties.



Map. 4. Distribution of the members of the *incanum* phylad.

(Oblong-leaved form): Connecticut. Hartford County. District of Columbia. Maryland. Baltimore, Montgomery, Prince Georges, and Washington counties. Massachusetts. Middlesex, Nantucket, Norfolk, Plymouth, and Suffolk counties. New Jersey. Bergen, Hunterdon, Ocean, and Sussex counties. New York. Broome, Chemung, Rensselaer, Tioga, and Westchester counties. Ohio. Jackson County. Pennsylvania. Bucks, Chester, Lancaster, Lehigh, Monroe, and Northampton counties. Vermont. Bennington and Rutland counties. Virginia. Augusta County.

3. P. albescens Torrey and Gray

P. albescens Torrey and Gray ex A. Gray, Amer. Jour. Sci., Ser. 1, 42: 45, 1842, based upon specimens collected in Louisiana by Ingalls and by Hale, and in Alabama by Gates; a specimen in the Gray Herbarium, collected by Hale, is suggested as the standard; it has only minute curled pubescence.

Koellia albescens Kuntze, Rev. Gen. 2: 520, 1891.

P. incanum var. *albescens* Chapm., Fl. Southern U. S., 316, 1860.

Perennial herbs as much as 150 cm. tall, commonly about 90 cm., their stems branching in the upper parts, the branches ascendent or divaricate-ascendent, the median internodes about equal to the subtending leaves, the lower nodes glabrate or becoming so, the upper pubescent with short curled hairs and bearing a few longer spreading hairs, these rarely dense, or pubescent with short curled hairs only; leaf blades ovate to ovate-lanceolate or elliptical, paler beneath, serrate, 2.5–7 cm. long, commonly about 5 cm., 1.2–2.5 cm. broad, bearing 4–5 pairs of lateral veins, the upper surface of the median leaves glabrous or with a few spreading hairs, the lower canescent with short curled hairs and bearing a few longer spreading hairs especially on the veins, both surfaces of the upper and floral leaves canescent with short curled hairs, the median petioles 4–12 mm. long, mostly about 6 mm.; glomerules terminal and solitary, or occasionally 2, loose, disposed in irregular corymbs, the branches apparent, canescent, the bracts of the involucre foliar, canescent, rarely with a few longer hairs; calyces canescent throughout with minute appressed hairs, without bristles at the tip, 3.5–5 mm. long, commonly about 4 mm., the lower pair of teeth ovate or oblong, obtuse, 1–1.3 mm. long, the upper connate to the middle or more, deltoid, obtuse, the free tips about .5 mm. long; corolla tube gradually enlarged upward, 3–4.5 mm. long, the upper lip 2–4 mm. tall.

The Texas and Gulf form, which bears only short curled hairs on the stem, seems on the whole to be more uniform, and the leaves tend to be smaller and narrower and more often rhomboid-elliptical. The largest are seldom over 5 cm. long. This form gradually merges into one bearing in addition a few or many longer spreading hairs on the stem, which is common in Missouri and Arkansas, and suggests *P. incanum*. Some of these have pubescence sufficiently dense as readily to be confused with *P. incanum*. However, in habit of leaf and the blunt or acute rather than acuminate calyx teeth, they seem still to be a part of this alliance. East of the Mississippi River *P. albescens* borders in distribution that of *P. Loomisii*, with which it seems to merge. The calyces also show variation, merging on the one extreme with *P. curvipes* and on the other with *P. incanum*. Such forms resemble *P. albescens* in other respects. Some specimens from western Florida are average. However, *Curtiss* 5981 from River Junction, *Berg* from Tallahassee, and *Biltmore Herb*. 7470 from Aspalaga have rather acute calyx teeth, but are scarcely referable either to *P. curvipes* or *P. floridanum*. They more nearly suggest a short-toothed form of *P. Loomisii*.

Distribution (of short-haired form).—ALABAMA. Mobile County. ARKANSAS. Ashley, Garland, Hempstead, and Pike counties. FLORIDA. Gadsden, Holmes, and Liberty counties. LOUISIANA. Bossier, Caddo, Calcasieu, Natchitoches, Rapides, and St. Tammany parishes. MISSISSIPPI. Adams, Copiah, Franklin, Harrison, Jackson, Simpson, Wayne, and Williamson counties. OKLAHOMA. Pushmataha County. TEXAS. Anderson, Bowie, Brazos, Cass, Cherokee, Harris, Montgomery, Polk, Rusk, Titus, and Walker counties.

(Long- and short-haired form): ALABAMA. Butler County. ARKANSAS. Ashley, Benton, Boone, Bradley, Carroll, Cleburne, Drew, Garland, Grant, Hempstead, Independence, Logan, Madison, Montgomery, Pike, Polk, Pope, Prairie, Pulaski, Sevier, Sharp, Washington, and Yell counties. FLORIDA. Holmes County. LOUISIANA. Morehouse Parish. MISSOURI. Barry, Butler, Christian, Dent, Douglas, Dunklin, Howell, McDonald, Oregon, Ozark, Perry, Pulaski, Reynolds, Ripley, Shannon, St. Genevieve, Texas, Washington, Wayne, and Wright counties. OKLAHOMA. Choctaw, Leflore, and Pushmataha counties. TEXAS. Bowie, Cherokee, Dallas, Marion, Upshur, and Wood counties.

4. **P. curvipes** comb. nov.

P. curvipes comb. nov.

K. curvipes Greene, Leafl. Bot. Obs. and Crit. 2: 140, 1911; type collected by J. K. Small (July 27, 1893) on Stone Mountain, DeKalb Co., Georgia (U. S. Nat. Herb.).

K. multiflora Small, Fl. SE. U. S. ed. 3: 1174, 1933; published without Latin diagnosis and without citation of type, nor was a type designated amongst the specimens at the New York Botanical Garden.

Perennial herbs as much as 150 cm. tall, commonly about 75 mm., their stems branching loosely in the upper parts, the median internodes longer than the subtending leaves, about equal, or rarely shorter, pubescent with short curled hairs only; leaf blades ovate-lanceolate to ovate, usually rounded at the base, serrate, 3–7.5 cm. long, commonly about 6 cm., 2–4 cm. broad, bearing 5–6 pairs of lateral veins, commonly 6, the upper surface of the median leaves glabrous, or minutely pubescent near the base, the lower canescent with short curled hairs, the veins pubescent with short hairs and frequently bearing a few hirsute spreading hairs especially on the midvein, both surfaces of the upper and floral leaves canescent, the median petioles 5–15 mm. long, mostly about 8 mm.; glomerules canescent, terminal and solitary, or occasionally 2, disposed in irregular corymbs, loose, their branches apparent, the bracts of the involucre foliar, canescent; calyces canescent or hoary throughout, 3–4.5 mm. long, commonly about 4 mm., the teeth nearly regular, acuminate, the lower pair .5–1.2 mm. long, commonly 1 mm., the upper connate to the middle or less; corolla tube gradually enlarged upward, 2–3.5 mm. long, the upper lip 1.5–3.5 mm. tall.

The leaves tend to be ovate and rounded at the base, suggesting those of *P. incanum*, and rarely bear a few longer hairs on the midveins of the median leaves. The plants collected in Tennessee, and less frequently those from Georgia, rarely have a few longer hairs on the lower parts of the stem in addition to the short curled pubescence. The calyces are fairly uniform; only rarely are the posterior teeth fused to the middle.

Distribution.—ALABAMA. Calhoun, Clay, and Lee counties. GEORGIA. DeKalb and Fannin counties. NORTH CAROLINA. Buncombe County. TENNESSEE. Davidson (Harpeth hills) and Polk counties.

5. **P. floridanum** sp. nov.

P. floridanum sp. nov.; type collected by J. V. Nash (no. 2259) at Sanford, Florida (U. S. Nat. Herb.).

Perennial herbs as much as 120 cm. tall, commonly about 85 cm., their stems branching freely in the upper parts, the median internodes longer than the subtending leaves, or about equal, pubescent with minute downwardly curled hairs, less often spreading, lower internodes glabrous; leaf blades ovate-lanceolate, shallowly serrate, the median 4.5–6.5 cm. long, 1.8–2.6 cm. broad, both surfaces glabrous, or with a few curled hairs in the veins, both surfaces of the floral and upper leaves canescent with short hairs; median petioles 3–6 mm. long; glomerules terminal, 1–3, disposed in irregular corymbs, loose, the branches apparent, subtended by a pair of leaflike bracts, the bracts of the involucre few, canescent; calyces pubescent with short hairs, 3.5–5 mm. long, commonly about 4 mm., the teeth narrowly deltoid, fused only slightly at the base; corolla tube gradually enlarged upward, 3–4 mm. long, the upper lip 1.5–2.5 mm. tall.[1]

The habit, particularly of the leaves, is more nearly that of *P. muticum;* the calyces are more nearly those of *P. incanum.*

Distribution.—FLORIDA. Alachua County: Gainesville; Hernando County; Hillsborough County: Tampa Bay; Madison County; Seminole County: Sanford; Volusia County: New Smyrna.

6. **P. Loomisii** Nutt.

P. Loomisii Nutt., Jour. Acad. Philad. 7: 100, Oct. 1834, based upon a specimen collected in Georgia. A specimen so named by Nuttall (no. 117), said to have been from Alabama, is in the Nuttall herbarium in the British Museum of Natural History; other than this there is apparently no authentic specimen preserved, either at the British Museum or in the Academy of Natural Sciences at Philadelphia.

P. incanum var. *Loomisii* Fern., Rhodora 37:440, 1935.

Perennial herbs rarely as much as 150 cm. tall, commonly about 85 cm., their stems branching in the upper parts, the median internodes about equal to the subtending leaves or longer, canescent with minute curled hairs only, or with a few additional longer spreading ones; leaf blades nearly elliptical, paler beneath, serrate, 4–8 cm. long, commonly about 5.5 cm., 1.5–3.5 cm. broad, bearing 4–5 pairs of lateral veins, the upper surface glabrous, the lower canescent with minute curled hairs, both surfaces of the upper and floral leaves canescent; median petioles 4–10 mm. long; glomerules loose, the branches apparent, terminal, 1–3, disposed in irregular corymbs, the bracts of the involucre canescent and bearing longer jointed bristles; calyces canescent throughout, 3–5.5 mm. long, commonly about 5 mm., the lower pair of teeth 1.5–2.5 mm. long, commonly about 2 mm., the upper acute, usually shorter than the lower pair, all tipped with longer jointed bristles; corolla tube gradually enlarged upward, 2.5–4 mm. long, the upper lip 2.5–3.5 mm. tall.

The upper calyx teeth are usually shorter than the lower pair. Except for this and the fact that the longer hairs are frequently absent, this species is scarcely separable from *P. Tullia.* Two specimens of *P. curvipes* have been collected at Auburn, Alabama, in company with this species, which suggests that a sterility barrier may exist between them.

Distribution (of short-haired form).—ALABAMA. Cullman, Henry, and Lee counties. GEORGIA. Clarke, Dougherty, Floyd, and Harlan counties. KENTUCKY. Bell, Harlan, Hickman, and McCreary counties. NORTH CAROLINA. Granville and Henderson counties. OHIO. Scioto County. SOUTH CAROLINA. Anderson County. TENNESSEE. Franklin, Hamblen, and Knox counties. VIRGINIA. Bedford, Dinwiddie, Greenville, Lee, Nansemond, Patrick, Pulaski, and Sussex counties. WEST VIRGINIA. Harrison County.

(Short- and long-haired form): ALABAMA. Henry, Lee, and Tuscaloosa counties. DELAWARE. New Castle County. FLORIDA. Leon County. GEORGIA. Fannin County. ILLINOIS. Gallatin, Jackson, and Pulaski counties. KENTUCKY. Bell, Carlisle, and Harlan counties. NORTH CAROLINA. Buncombe, Halifax, Haywood, Rowan, and Transylvania counties. OHIO. Scioto County. SOUTH CAROLINA. Anderson County. TENNESSEE. Davidson and Knox counties. VIRGINIA. Nansemond, Norfolk, Patrick, and Pulaski counties.

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[1] Herbae perennes altitudine ad 120 cm. saepius circiter 85 cm. superne sat ramosis, internodiis mediis quam foliorum laminae saepius longioribus, pilis minutis decurvis pubescentibus, internodiis inferioribus glabris; foliorum laminis ovato-lanceolatis, leniter serratis, mediis 4.5–6.5 cm. longis, 1.8–2.6 cm. latis, utrimque glabris vel ad venas sparse pubescentibus; petiolis mediis 3–6 mm. longis; glomerulis irregulariter corymbosis paucis, manifeste ramosis, bracteis foliosis utrimque molliter canescentibus paucis; calycibus pilis brevibus curvis pubescentibus, 3.5–5 mm. longis, saepius circiter 4 mm., dentibus anguste deltoideis, posticis tribus in basi vix connatis; corollarum tubo gradatim ampliato, 3–4 mm. longo, labia superiore 1.5–2.5 mm. alta.

7. **P. Tullia** Benth.

P. Tullia Benth., Lab. Gen. et Sp. 328, Apr. 1834, based upon *Tullia pycnanthemoides* Leavenworth, loc. cit.

K. Tullia Millsp., Fl. W. Va. 425, 1892.

Tullia pycnanthemoides Leavenworth, Amer. Jour. Sci., Ser. I, 20: 343, t. 5, 1830; type collected by Leavenworth on Paint Mountain in eastern Tennessee (N. Y. Bot. Gard.); a portion is in the herbarium of the Philadelphia Academy of Natural Sciences. The type, which was apparently the specimen illustrated, is an unusually open form near maturity.

P. pycnanthemoides Fern., Rhodora 10: 86, 1908. Following the International Rules, Fernald's combination is the valid name.

Koellia pycnanthemoides Kuntze, Rev. Gen. 2: 520, 1891.

Perennial herbs as much as 150 cm. tall, commonly 90–100 cm., their stems branching loosely in the upper parts, the median internodes about equal to the subtending leaves or longer, canescent with minute curled hairs and fewer longer spreading ones; leaf blades broadly lanceolate or oblong-lanceolate, usually narrowed toward the base, paler beneath, serrate, the median 3.5–9 cm. long, commonly about 6 cm., 1–5–3.5 cm. broad, the upper surface glabrous, the lower canescent and bearing longer spreading hairs especially on the veins, both surfaces of the floral and upper leaves canescent; median petioles 3–8 mm. long; glomerules terminal, 1–3, or rarely 4, disposed in irregular corymbs, loose, the branches apparent, the bracts of the involucre canescent and bearing longer jointed bristles; calyces canescent, 3.5–6 mm. long, commonly about 5 mm., the teeth narrow, acute, the lower pair 1.5–2.6 mm. long, usually about 2 mm., the upper pair ⅛–½ as long, usually extending beyond the lower pair, tipped with jointed bristles; corolla tube gradually enlarged upward, 2.5–4.5 mm. long, the upper lip 2–3.5 mm. tall.

Both short curled and long spreading hairs are present on the stems. The calyces are variable. The upper teeth are usually shorter than the lower, but may be longer, although the plant habit is that of *P. Tullia.* The specimens collected in Indiana seem to be fairly constant, while those collected in areas with other forms seem to be more variable in pubescence and in shape of calyces. The species is confluent with *P. Loomisii.*

Distribution.—Georgia. Fannin, Floyd, Haversham, and Rabun counties. Illinois. Gallatin, Jackson, and Massac counties. Indiana. Clark, Crawford, Dubois, Franklin, Greene, Harrison, Knox, Lawrence, Martin, Orange, Perry, Posey, Spencer, and Washington counties. Kentucky. Harlan and Lyon counties. North Carolina. Buncombe, Durham, Henderson, Madison, Mitchell, and Polk counties. South Carolina. Anderson and Pickens counties. Tennessee. Blount, Cocke, Davidson, Hamilton, Sevier, and Sumner counties. Virginia. Patrick County. West Virginia. Calhoun and Wayne counties.

8. **P. viridifolium** comb. nov.

P. viridifolium comb. nov.

P. pycnanthemoides var. *viridifolium* Fern., Rhodora 39: 445, 1937; type collected by Fernald *et al.* (no. 6678) in Virginia in dry sandy woods and thickets near James River Junction, Greenville County (Gray Herb.).

Perennial herbs as much as 140 cm. tall, commonly about 85 cm., their stems branching in the upper parts, the branches ascendent or divaricate-ascendent, the median internodes longer than the subtending leaves, or rarely a little longer, thinly hirsute with spreading hairs only, these long and short, or long only; leaf blades broadly lanceolate or ovate-lanceolate, tending to be rounded at the base, paler beneath, but green and not canescent, serrate, 4–10 cm. long, commonly about 7 cm., 2–4 cm. broad, bearing 4–5 pairs of lateral veins, thinly hirsute with spreading hairs, especially on the veins beneath, both surfaces of the upper leaves and bracts canescent with short appressed hairs; median petioles 6–12 mm. long; glomerules terminal, 1–3, rarely 4, disposed in irregular corymbs, loose, the branches apparent, the bracts of the involucre canescent with short appressed hairs and bearing longer jointed bristles; calyces 4–6 mm. long, commonly about 5 mm., canescent throughout with minute appressed hairs, the lower pair of teeth 1.5–3 mm. long, usually about 2 mm., the upper ½–⅓ as long, acuminate, tipped with longer jointed bristles; corolla tube gradually enlarged upward, 3–5 mm. long, the upper lip 2–4 mm. tall.

The pubescence of the stem consists of long and short spreading hairs, or long hairs only. The short curled type of pubescence is entirely absent and the stems and leaves (except the bracts) are not at all canescent. The leaf blades vary from ovate-lanceolate to broadly lanceolate. The tendency is to be rounded at the base. The calyces show some variation.

Distribution (of short- and long-haired forms).—ALABAMA. Henry, Lee, and Tuscaloosa counties. GEORGIA. McDuffie County. NORTH CAROLINA. Burke, Caldwell, Cleveland, Iredell, McDowell, Moore, Orange, and Rockingham counties. SOUTH CAROLINA. Anderson and Greenville counties. TENNESSEE. Carter County. VIRGINIA. Bedford, Bland, Carroll, Greenville, James City, Pulaski, Rockbridge, and Smyth counties. WEST VIRGINIA. Mercer County.

(Form with long hairs only): NORTH CAROLINA. Burke, Northampton, and Swain counties. SOUTH CAROLINA. Greenwood County. VIRGINIA. Fauquier and Stafford counties. WEST VIRGINIA. Fayette County.

9. **P. puberulum** sp. nov.

P. puberulum sp. nov.; type collected by R. M. Harper (no. 586), near Leslie, Sumter County, Georgia (U. S. Nat. Herb.).

Perennial herbs about 90 cm. tall, their stems loosely branched in the upper parts, the median internodes about equal to the subtending leaves, or a little longer, pubescent with rather sparse downwardly curled hairs only, not at all canescent; leaf blades ovate-lanceolate, rounded at the base, lighter beneath, serrate, the median largest, 5–10 cm. long, commonly about 6 cm., 2–3.5 cm. broad, the upper surface glabrous or with a few spreading or curled hairs, the lower canescent, the veins pubescent like the stems; petioles of the median leaves 4–8 mm. long; glomerules canescent with short appressed hairs, terminal, 1–3, disposed in irregular corymbs, loose, the branches apparent, the bracts of the involucre canescent with short appressed hairs, and bearing in addition a few longer jointed bristles; calyces canescent throughout with short appressed hairs, 3.5–5.5 mm. long, commonly about 4 mm., the posterior three teeth connate at the base, usually about ⅓–½ as long as the anterior pair, which are commonly 1.5–2 mm. long, the anterior pair usually longer than the posterior, acuminate, tipped with a few longer jointed bristles; corolla tube gradually enlarged upward, 3–4 mm. long, the upper lip 2–3.5 mm. tall.[2]

The stem pubescence is of a different order from that found in most of the species of the group to which it belongs. The pubescence consists of rather sparse but somewhat coarser downwardly curled hairs; the short dense type of pubescence is entirely lacking. The same type of pubescence is usually present on the veins of the leaves.

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[2] Herbae perennes altitudine circiter 90 cm. superne plus minusve ramosis, internodiis mediis foliorum laminas subaequantibus pilis decurvis sparse pubescentibus nullomodo canescentibus; foliorum laminis ovato-lanceolatis, 5–10 cm. longis plerumque circiter 6 mm. longis, 2–3.5 cm. latis, mediis saepius maximis, omnibus in basi rotundatis, serratis, pagina superiore glabrata, inferiore cinerea; petiolis foliorum mediorum 4–8 mm. longis; glomerulis pilis brevibus appressis canescentibus, saepius 1–3 irregulariter corymbosis manifeste ramosis, bracteis pilis appressis brevibus canescentibus et setis sparse ornatis; calycibus pilis brevibus appressis utrimque canescentibus 3.5–5.5 mm. longis, saepius circiter 4 mm., dentibus posticis in basi connatis saepius tertia vel dimidia parte anticorum, anticis saepius 1.5–2 mm. longis, acuminatis, in apice sparse setosis; corollarum tubo gradatim ampliato, 3–4 mm. longo, labia superiore 2–3.5 mm. alta.

Distribution.—ALABAMA. Lee County. FLORIDA. Franklin County. GEORGIA. Habersham, Rabun, Sumter, and Troup counties. NORTH CAROLINA. Northampton and Polk counties. SOUTH CAROLINA. Pickens County. WEST VIRGINIA. Fayette County.

10. P. **Beadlei** Fernald

P. Beadlei Fernald, Rhodora, 39: 446, 1937.

Koellia Beadlei Small, Bull. Torr. Bot. Club, 25: 470, 1898; type collected in North Carolina near Highlands, Macon County, and distributed by the Biltmore Herbarium as No. 5744 (N. Y. Bot. Gard.).

Perennial herbs commonly about 75 cm. tall, their stems simple or branching in the upper parts, the median internodes ½–⅔ as long as the subtending leaves, rarely about equal, pubescent with rather sparse downwardly curled hairs; leaf blades ovate-lanceolate, shallowly serrate, the median largest, 6–8.5 cm. long, commonly about 7 cm., 2–3.5 cm. broad, the upper surface glabrous or with a few spreading hairs, the lower usually pubescent with spreading hairs along the veins, upper surface of the floral bracts pubescent with long and short matted hairs, the median petioles usually about 3 mm. long; glomerules terminal, 1–4, subtended by a pair of leaflike bracts, the involucre formed of a few spreading lanceolate ciliate bracts; calyces pubescent with a few short hairs, 5.5–7 mm. long, commonly about 6 mm., the teeth narrowly deltoid, acuminate, the posterior connate at the base, about ⅔ as long as the anterior pair, which are 1.5–2.5 mm. long; corolla tube slightly enlarged upward, 5–6 mm. long, the upper lip 3–3.5 mm. tall.

Distribution.—NORTH CAROLINA. Buncombe County: near Pisgah; Iredell County: Statesville; Macon County: Highlands, Horse Cove; Rutherford County: Rock Mountain. SOUTH CAROLINA. Greenville County: Caesars Head.

11. P. **montanum** Michx.

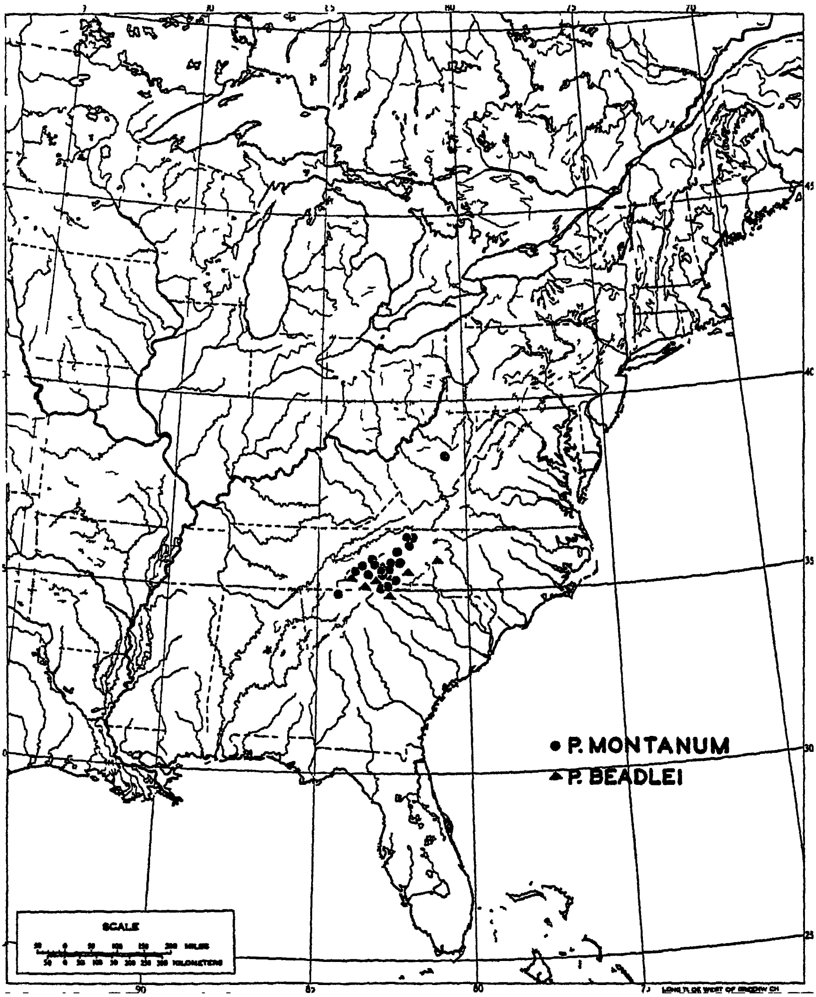
P. montanum Michx., Fl. Bor. Amer. 2: 8, 1803, based upon specimens collected in the mountains of North Carolina; the specimen in the Michaux herbarium is very similar to one collected on Roan Mountain, by Curtiss (no. 2004).

Monardella montana Benth., Lab. Gen. et Sp. 331, 1834, based upon *P. montanum* Michx.

Koellia montana Kuntze, Rev. Gen. 2: 520, 1891.

Perennial glabrous herbs rarely as much as a meter tall, commonly 50–60 cm., their stems sometimes simple but more often sparingly branched in the upper parts, the branchlets slender, ascending, the median internodes usually about equal to the subtending leaves, or shorter, less often longer; leaf blades commonly ovate-lanceolate, rarely ovate, frequently lanceolate or even elliptical, the largest occurring usually at the base of the lowest branchlets, these 6–12 cm. long, usually about 8.5 cm., 2–4.5 cm. broad, acute or acuminate, rounded or narrowed at the base, their margins sharply serrulate, the lower surfaces paler; median petioles as long as 8 mm.; glomerules solitary and terminal, or occasionally 2 or 3 in the upper axils and remote, usually subtended by a pair of diminished leaves which may sometimes be bractlike, the involucre formed of a few spreading lanceolate, ciliate bracts which scarcely exceed the calyces; calyces bristling in the upper parts with rather coarse jointed hairs, glabrous for the rest or minutely and sparingly puberulent, 5–7.5 mm. long, commonly about 6 mm., the teeth narrowly deltoid, somewhat acuminate, mucronate, the posterior three connate at the base, about ⅔ as long as the anterior pair, which are commonly 1–2 mm. long; corolla tube pubescent within the throat, essentially tubular below the lip, but little expanded upward, 4–7.5 mm. long, commonly about 6 mm., the upper lip 2.5–4 mm. tall, commonly about 3–3.5 mm.; nutlets hairy at the apex.

There is a wide variation in leaf size and leaf proportion. The blades may be rounded or narrowed toward the base Otherwise, this species is stable and very distinct.



Map 5. Distribution of *P. Beadlei* and *P. montanum*.

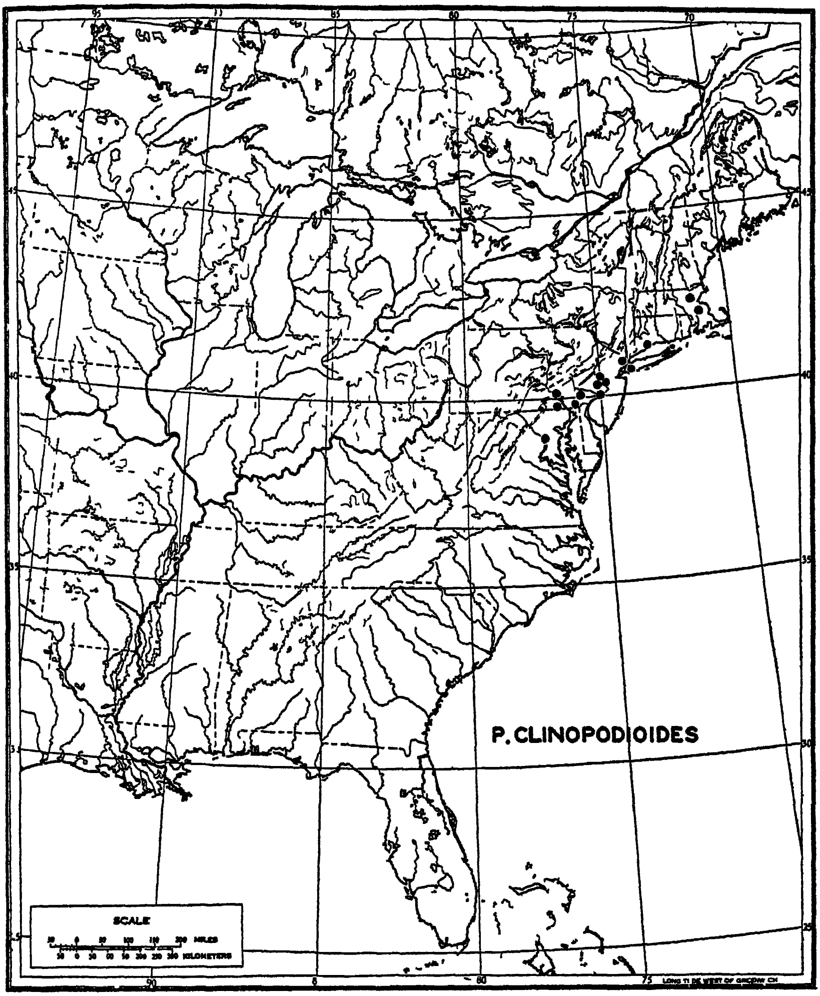
Distribution.—GEORGIA. Fannin County. NORTH CAROLINA. Buncombe, Henderson, Mitchell, Polk, and Swain counties. SOUTH CAROLINA. Greenville County. TENNESSEE. Carter, Cocke, and Sevier counties. WEST VIRGINIA. Nicholas County.

12. P. clinopodioides Torr. and Gray

P. clinopodioides Torr. and Gray ex A. Gray in Amer. Jour. Sci., Ser. I, 42: 45, 1842, based upon specimens collected "in the vicinity of New York City and in New Jersey"; the standard may be taken as a specimen in the Gray Herbarium collected in New Jersey by J. Carey.

Koellia clinopodioides Kuntze, Rev. Gen. 2: 520, 1891.

Perennial herbs as much as a meter tall, commonly about 80 cm., bearing short leafy branches in the axils of the leaves and branching in the inflorescence, the median internodes about equal to the subtending leaves, pubescent with uneven, short, usually downwardly curled hairs with a few longer spreading hairs as well, all sometimes spreading; leaf blades narrowly lanceolate, entire, or shallowly serrate, the largest median, 4.5–9.5 cm.



Map 6. Distribution of *P. clinopodioides.*

long, commonly about 6 cm., 1–2.5 cm. broad, the upper surface sprinkled with a few hairs, the lower pubescent with longer spreading hairs, especially on the midrib and other veins; median petioles 3–6 mm. long; glomerules terminal, 1–3 on a peduncle, disposed in loose corymbs, each subtended by a pair of leaflike bracts which may be canescent, the inner bracts with a few long jointed bristles; calyces pubescent with short hairs, 4–6 mm. long, commonly 4.5 mm., the teeth narrowly deltoid, somewhat acuminate, ciliate with several jointed bristles at the tip, the posterior three somewhat connate at the base, about ⅔ as long as the anterior pair, which are commonly 1–1.5 mm. long; corolla tube rather abruptly narrowed above the middle, 4–5.5 mm. long, the upper lip 3–4 mm. tall; nutlets glabrous or sometimes hairy at the tip.

The calyces seem to be fairly constant in shape, showing only variation in size. There is an appreciable difference in the number of long jointed bristles on the calyx teeth, and the bristles are not as long as those found on other species possessing them. This species is rather variable in habit and suggests strongly a hybrid origin between a member of the *P. incanum* group and one of the narrow leaved species, such as *P. verticillatum*.

Distribution.—CONNECTICUT. New Haven County. DISTRICT OF COLUMBIA. MARYLAND. Howard County. MASSACHUSETTS. Middlesex and Norfolk counties. NEW JERSEY. Bergen, Hunterdon, and Mercer counties. NEW YORK. Nassau County. NORTH CAROLINA. Rutherford County. PENNSLVANIA. Bucks, Chester, Lancaster, and Philadelphia counties. WEST VIRGINIA. Calhoun County.

13. **P. pilosum** Nutt.

P. pilosum Nutt., Gen. Amer. Pl. 2: 33, 1818, based upon specimens collected by Nuttall in Kentucky and Tennessee; a specimen which may be considered the standard is preserved in the British Museum.

P. muticum var. *pilosum* Gray, Syn. Fl. N. Amer. 2: 355, 1878.

Koellia pilosa Baill., Hist. Pl. 10: 31, 1892.

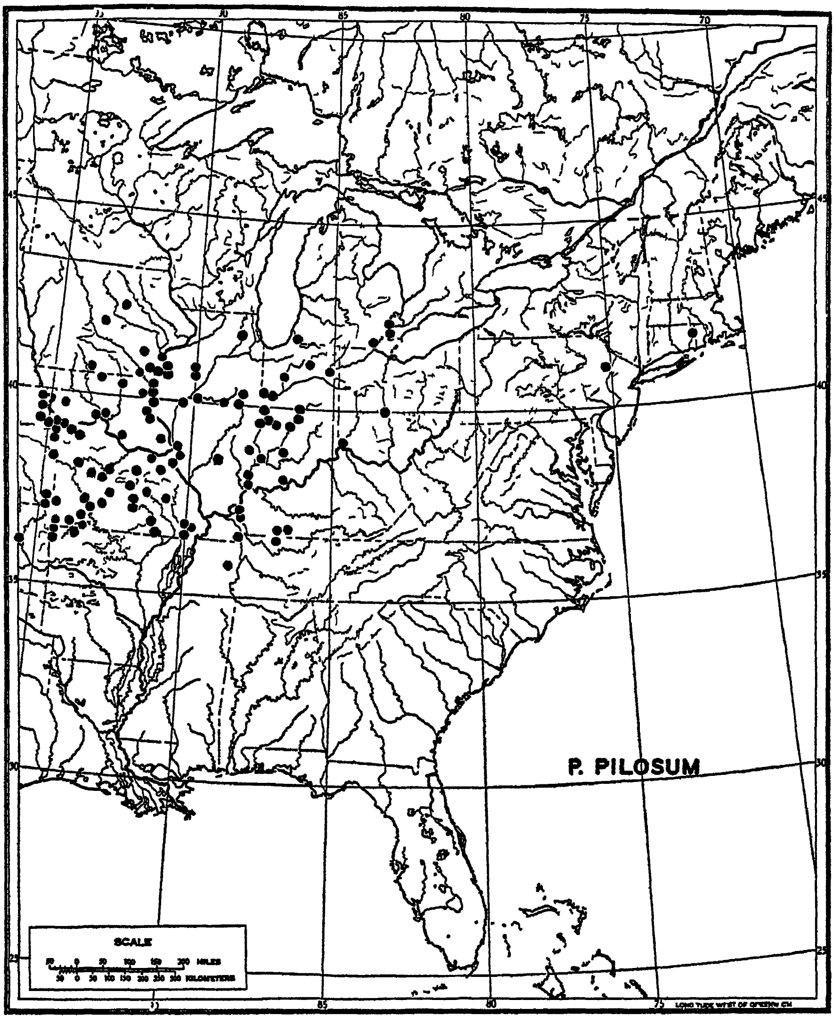
K. verticillata var. *pilosa* Kuntze, Rev. Gen. 2: 520, 1891.

Perennial herbs rarely as much as 150 cm. tall, commonly 90–100 cm., their stems rather densely pilose throughout with spreading hairs, bearing short lateral branches in the axils of the leaves and branching freely in the inflorescence, the whole plant appearing very leafy, the median internodes about equal to the subtending leaves; leaf blades commonly lanceolate, the largest usually median, 3.5–7 cm. long, usually about 5 cm., .8–2 cm. broad, commonly 1.2 cm., entire or shallowly serrate, the upper surface of the lower leaves essentially glabrous, those of the upper sparingly pilose, the lower surfaces of all pilose, especially along the veins, the principal veins usually four pairs, the intermediate veins not obvious, essentially sessile, the longest petioles not more than 3 mm.; glomerules terminal and solitary, or occasionally 2, the outer bracts subfoliar, canescent; calyces shaggy-canescent with short matted hairs, 3.5–4.5 mm. long, commonly about 4 mm., the teeth narrowly deltoid, acute rather than acuminate, shortly bristle-tipped, the posterior three somewhat connate at the base, the anterior pair commonly .9 mm. long; corolla tube gradually enlarged upward, 3–5 mm., commonly 4 mm. long, the upper lip 2–3 mm. tall.

There is a marked range of variation in the amount of canescence on the calyces and pubescence on the stem which does not seem to be correlated with distribution. There is also a wide range of variation in leaf size. Usually the leaves are less than 1.5 cm. broad, but rarely they are as wide as 2 cm. Although far out of range, the specimens from Stroudsburg, Pennsylvania, and from Kensington and Plainfield, Connecticut, appear to be quite typical. The last named is represented by two independent collections.

Distribution.—ARKANSAS. Benton, Carroll, and Washington counties. CONNECTICUT. Hartford and Windham counties. ILLINOIS. Adams, Cass, Champaign, Hancock, Henderson, Kane, Macon, Marion, Mason, Menard, Peoria, Richland, and St. Clair counties. INDIANA. Allen, Clay, Hamilton, Kosciusko, Martin, Morgan, Perry, Posey, Vermillion, Vigo, Warren, and White counties. IOWA. Black Hawk, Decatur, Des Moines, Henry, Johnson, Louisa, Story, and Van Buren counties. KANSAS. Atchison, Cherokee, Doniphan, Jefferson, Johnson, Leavenworth, Miami, and Wyandotte counties. KENTUCKY. Calloway, Crittenden, Lyon, Simpson, and Warren counties. MICHIGAN. Berrien and Monroe counties. MISSOURI. Adair, Barry, Boone, Camden, Carroll, Carter, Chariton, Christian, Clinton, Dunklin, Franklin, Greene, Hickory, Iron, Jackson, Jasper, Jefferson, Johnson, Laclede, Lewis, Lincoln, Madison, Maries, Marion, McDonald, Miller, Oregon, Phelps, Putnam, Rolls, Shannon, St. Clair, St. Louis, Stoddard, Stone, Washington, and Webster counties. OHIO. Franklin and Hamilton counties. OKLAHOMA. Stephens and Wagoner counties (Verdigris R.).

CANADA. ONTARIO. Leamington.

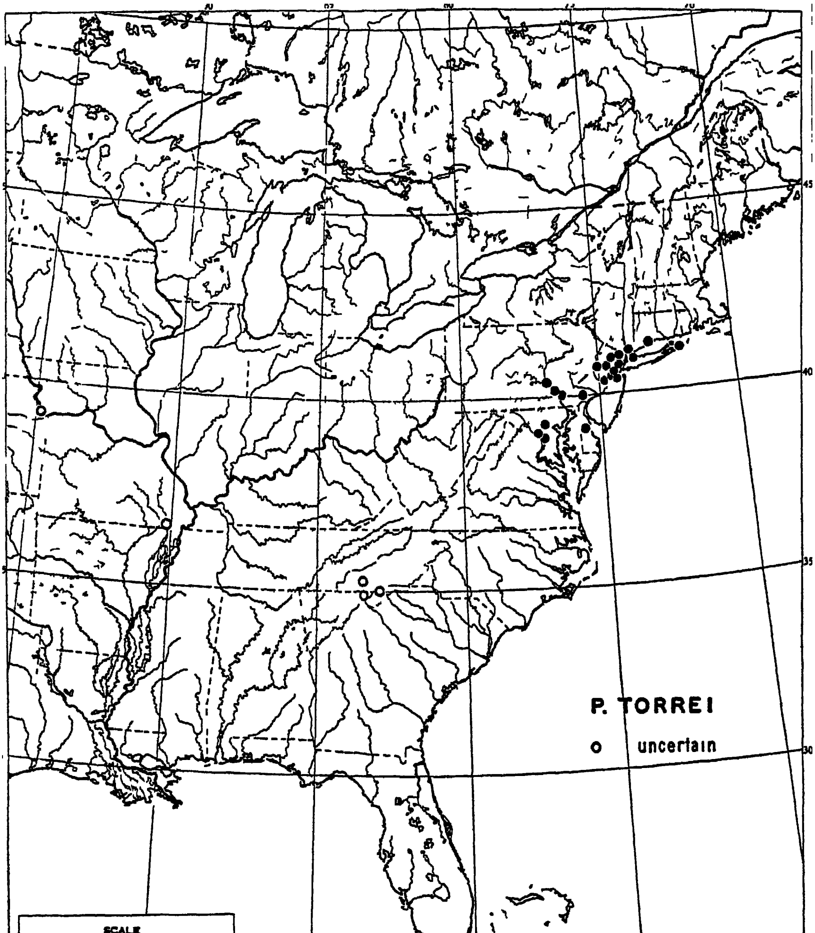


Map 7. Distribution of *P. pilosum*.

14. P. Torrei Benth.

P. Torrei Benth., Lab. Gen. et Sp. 329, 1834; type collected by Torrey near Princeton, New Jersey (Kew); a probable portion, similar in all respects, is in the Torrey Herbarium. *Koellia Torreyi* Kuntze, Rev. Gen. 2: 520, 1891.

Perennial herbs as much as a meter tall, commonly 70–80 cm., their stems branching in the upper parts, with short lateral branches, the median internodes about equal to the subtending leaves, or longer, rarely shorter, rather thinly pubescent, the hairs uneven, spreading, or curling upward; leaf blades narrowly lanceolate, narrowing toward the base, thin and flaccid, the median 4.5–9 cm. long, commonly 6.5 cm., .5–1 cm. broad, entire or the larger serrate, essentially glabrous, scabrous along the edges, the midvein sometimes hairy, bearing commonly 3–5 pairs of veins, the uppermost pair extending to the tip, median petioles 1–4 mm. long; glomerules terminal, 2–3, disposed in corymbs, subtended by a pair of leaflike bracts, the inner bracts leaflike, with a prominent midrib, their edges pilose; calyces 4–5 mm. long, pubescent chiefly in upper parts with spreading hairs, the teeth lanceolate, somewhat acuminate, the posterior three slightly fused at the base, the anterior pair 1–2 mm. long, pubescent on the edges with rather stiff hairs; corolla gradually enlarged upward, 3.5–5 mm. long, the upper lip 2.5–3.5 mm. tall; nutlets glabrous or sometimes hairy at the tip.



Map 8. Distribution of *P. Torrei.*

This species is distinguished from *P. verticillatum* chiefly by the nature of the calyx teeth, which are longer and sharpened, and by the flaccid, less veiny leaves. However, specimens occur which are difficult to define, particularly in Pennsylvania. The collections made by Small and by Heller in Lancaster

County are least typical. Otherwise the species is fairly uniform. The plants of Georgia and South Carolina seem scarcely different from those of New York and New Jersey. Those from North Carolina are quite narrow-leaved but appear to be almost identical with specimens collected at Felton, Delaware, by Canby. The specimens from Missouri and Kansas referred to here are scarcely separable on the grounds of gross morphology, except in the smaller heads. However, they may represent hybrid forms of local origin, for the Kansas specimen was gathered with *P. pilosum.* If they are in fact *P. Torrei,* their distribution may be significant in fixing the age of the genus in view of Steyermark's analysis of the Ozark flora (Rhodora 36 :214–233, 1934). The specimens from North Carolina are similar to *P. leptodon* but much less hairy. The stem pubescence is variable but always scant and usually spreading.

Distribution.—CONNECTICUT. New Haven County. DELAWARE. Kent County. DISTRICT OF COLUMBIA. GEORGIA. Rabun County: Estatoah Falls. KANSAS. Wyandotte County: Rosedale. MARYLAND. Howard County. MISSOURI. Dunklin County. NEW JERSEY. Essex, Hunterdon, Mercer, Middlesex, Monmouth, Morris, and Passaic counties. NEW YORK. Nassau, New York, Suffolk, and Westchester counties. NORTH CAROLINA. Jackson County: Cullowhee. PENNSYLVANIA. Chester, Dauphin, Lancaster, and Lehigh counties. SOUTH CAROLINA. Greenville: Caesars Head. WEST VIRGINIA. Fayette County.

15. **P. verticillatum** Pers.

P. verticillatum Pers., Syn. 2: 128, 1807.

Brachystemon verticillatum Michx., Fl. Bor. Amer. 2: 6, pl. 31, 1803, based upon specimens collected in Pennsylvania and North Carolina; the specimen in the Michaux herbarium is very similar to one in the Academy of Natural Sciences at Philadelphia collected in Pennsylvania near Wurtemburg by J. A. Shafer; a fragment is in the Gray Herbarium.

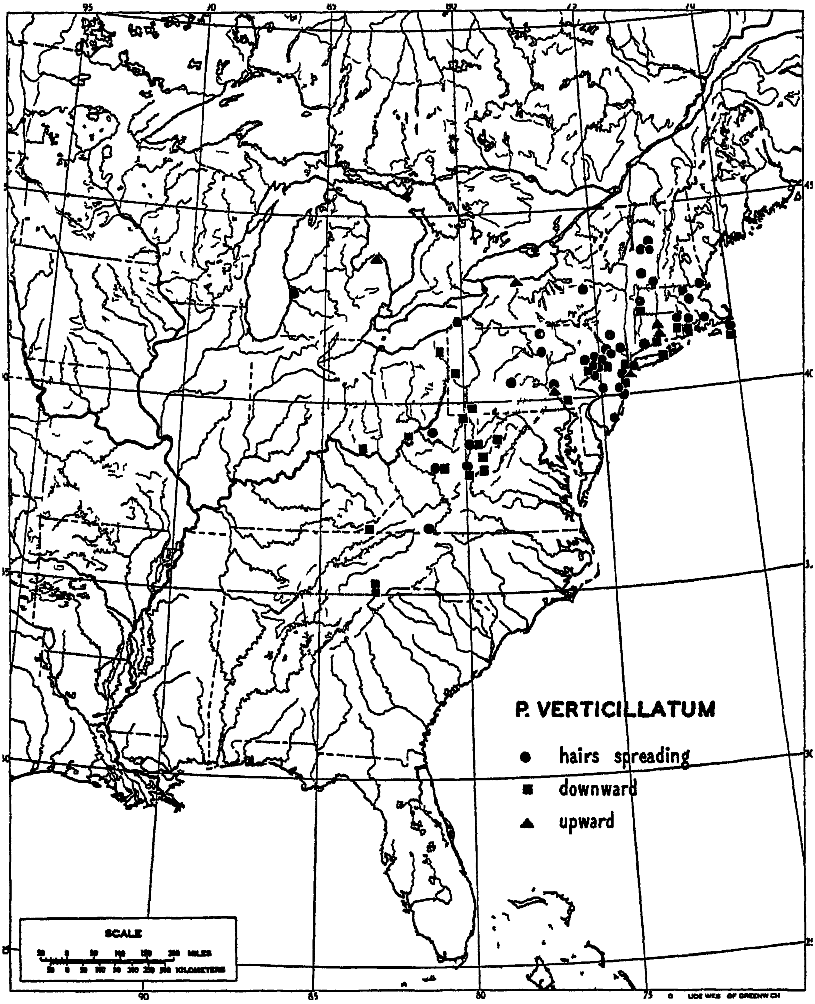
Koellia verticillata Kuntze, Rev. Gen. 2: 520, 1891.

K. verticillata var. *glabrior* Kuntze, l. c., based upon a specimen collected near Cairo (?), Mississippi by Kuntze.

K. huronensis Greene, Leafl. Bot. Obs. and Crit. 2: 140, 1911, based upon a specimen collected at Caseville, Michigan, on Saginaw Bay by C. H. Dodge, Sept. 9, 1910; a specimen with these data is in the U. S. National Herbarium.

Perennial herbs as much as a meter tall, commonly 70–80 cm., their stems branching in the upper parts, usually with short lateral branches in the axils of the leaves, the median internodes about equal to the subtending leaves, or a little longer, rather thinly pubescent on all sides, the hairs spreading or curved downward, rarely upward; leaf blades lanceolate, the largest median, 4–7 cm. long, commonly about 5 cm., 10–16 mm. broad, entire or shallowly serrate, sparingly pubescent chiefly along the veins beneath, the principal veins 4–5 pairs with weaker secondary veins, the median petioles rarely 2 mm. long; glomerules terminal, 1–2, or rarely 3 on a peduncle, disposed in loose irregular corymbs, the bracts of the involucre essentially leaflike, the midvein not notably thickened, the inner pubescent, the outer incanous with short hairs, velvety, especially on the upper surfaces; calyces mostly pubescent with short hairs in the upper parts, 3.5–4.5 mm. long, the teeth narrowly deltoid and somewhat acuminate but scarcely mucronate, .8–1 mm. long, pubescent; corolla tube gradually enlarged upward, 2–3.5 mm. tall; stamens minute, scarcely exserted from the throat, apparently nonfunctional; nutlets glabrous, or tipped with a few hairs.

The degree of canescence of the bracts is the most variable thing within the species, but this canescence is always present to some degree. This species can be separated from *P. virginianum* most certainly by the canescent bracts, and by the stem pubescence, which is usually on all sides of the stem and not confined to the angles as in *P. virginianum*. It may be distinguished from the narrow-leaved forms of *P. muticum* chiefly by the greater number of veins in the leaves of that species.



Map 9. Distribution of *P. verticillatum.*

Distribution (of form with spreading hairs).—CONNECTICUT. Fairfield and Windham counties. MASSACHUSETTS. Berkshire, Bristol, Essex, Middlesex, and Nantucket counties. MICHIGAN. Huron and Ottawa counties. NEW JERSEY. Atlantic, Monmouth, Sussex, and Warren counties. NEW YORK. Livingston, Oneida, Orange, and Queens counties. PENNSYLVANIA. Allegheny, Bradford, Bucks, Erie, Fayette, Huntingdon, Lancaster, Lycoming, Monroe, Northampton, and Pike counties. RHODE ISLAND. Kent and Providence counties. VERMONT. Bennington, Chittenden, Rutland, and Windham counties. VIRGINIA. Augusta and Carroll counties. WEST VIRGINIA. Nicholas, Pocahontas, Randolph, and Ritchie counties.

(Form with downwardly directed hairs): CONNECTICUT. New Haven and New London counties. MASSACHUSETTS. Berkshire, Middlesex and Nantucket counties. NEW JERSEY. Monmouth, Sussex, and Warren counties. NEW YORK. New York, Richmond, and Suffolk counties. NORTH CAROLINA. Jackson County. OHIO. Adams, Meigs, and Trumbull counties. PENNSYLVANIA. Bucks, Fayette, Lancaster, Lawrence, and Northampton counties. VERMONT. Windham County. VIRGINIA. Bath, Carroll, and Lee counties. WEST VIRGINIA. Hardy, Monongalia, Nicholas, and Pendleton counties.

(Form with upwardly curled hairs): CONNECTICUT. Hartford County. MICHIGAN. Huron County. NEW YORK. Monroe and Richmond counties. PENNSYLVANIA. Lancaster County. WEST VIRGINIA. Randolph County.

16. **P. virginianum** Durand and Jackson

P. virginianum Durand and Jackson ex Robins. and Fern., Man. 707, 1908, based upon *Satureja virginiana* L., loc. cit. "*P. virginianum* is merely a typographical or clerical error for *P. virginicum*. It occurs in Durand and Jackson, Ind. Kew Suppl. 1: 353, 1906, followed by '= *lanceolatum* Pursh,' so it is only a synonym at best. Only two years after the blunder, the binomial was duly published (*virginianum is* the oldest and hence the correct specific name), credited to 'Durand and Jackson' (instead of to Trelease to whom they erroneously cited it); and as far as I know the correct citation is *Pycnanthemum virginianum* Durand and Jackson, ex Robinson and Fernald, Man. 707, 1908."—J. H. Barnhart, in litt.

Satureja virginiana L., Sp. Pl. 567, 1753. From a study of the plants referred to by Linnaeus under this name it is clear that he first described in the Hort. Cliff. the species now known as *P. flexuosum* (*P. linifolium* Pursh) and annotated this name in Gronovius' Flora where Clayton's plant No. 141 is referred to. The plant of the Hort. Cliff. and Clayton's plant are conspecific and are similar to a plant collected by P. Wilson (no. 103), at Dalton, Georgia (erroneously said by Epling, Jour. Bot. 1929, to have been collected by R. M. Harper, by whom it was distributed). The plants of the Morison and Plukenet Herbaria, which Linnaeus referred to are also conspecific. The species was interpreted in this sense by Michaux, Persoon, Pursh and Poiret; Bentham, however, adopted Pursh's name which was continued in use until Durand and Jackson restored the Linnaean name of *P. virginianum*.

However, Linnaeus had in his herbarium at the time of the first enumeration a specimen of what was later described by Pursh as *P. lanceolatum*. It is to this specimen that the epithet "virginianum" was referred, by Durand and Jackson. Since it has become well established in this usage it seems preferable not to make another change, although a strict interpretation of priority would apply this name to *P. flexuosum*. This specimen is well matched by *House 405* collected at New Alexandria, Va.

P. virginicum Pers., Syn. 2: 128, 1907, based upon *Thymus virginicus* L., Mant. 2: 409, 1771, which is based in turn upon *Satureja virginiana* L., loc. cit.

P. lanceolatum Pursh, Fl. Amer. Sept. 2: 410, 1814; the specimen among the Pursh plants at Kew is without data of collection; no specimens are preserved at Philadelphia.

P. lanceolatum var. *angustifolium* Benth., Lab. Gen. et Sp. 330, 1834; it is impossible to ascertain from Bentham's citations and his note what form is referred to.

P. virginianum Trel. ex Branner and Coville in Ann. Rep. Geol. Surv. Ark. for 1888, III, 1891.

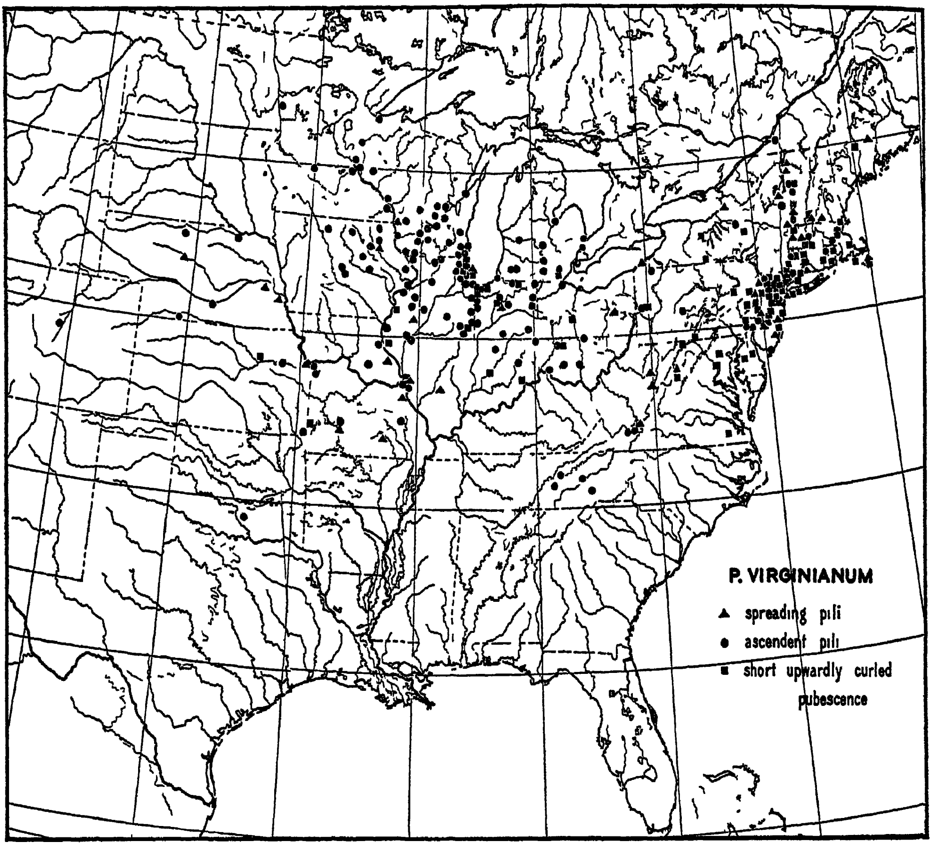
Brachystemum lanceolatum Willd., Enum. Hort. 2: 623, 1809.

B. virginicum Michx., Fl. Bor. Amer. 2: 6, 1803, for name only, based upon *Thymus virginicus* L., loc. cit.; the specimens in Michaux's herbarium are conspecific with the plants of the Hort. Cliff. and Gronovian herbarium; that is, they are referable to *P. linifolium* Pursh and are similar to *Fernald, Butters and St. John* 262.

Thymus lanceolatus Poir., Suppl. 5: 305, 1804; the type is not clear. Specimens in the Cosson herbarium referred by Poiret to *Thymus virginicus* are *P. muticum, incanum* and the present species.

K. fascicularis Greene, Leafl. Bot. Obs. and Crit. 2: 139, 1911, based upon specimens collected near Chicago by *L. F. Ward*, 1897, and by *A. Chase*, 1901; both specimens are in the U. S. National Herbarium.

Perennial herbs as much as 1 m. tall or more, commonly about 70 cm., bearing short leafy lateral branches in the upper parts, the median internodes about equal to the subtending leaves, or longer, rarely shorter, those of the lateral branches much shorter, the pubescence confined chiefly to the angles, variable; leaf blades lanceolate or linear-lanceolate, often tending to linear-elliptical, sessile, entire or rarely shallowly serrate, the median 3.5–6.5 cm. long, commonly about 4.5 cm., 6–11 mm. broad, glabrous or sparingly pubescent along the veins, scabrous, usually with 4 pairs of lateral veins, the pair which extends to the tip arising near the middle; glomerules dense, terminal and solitary, or rarely 2, disposed in rather compact corymbs, the bracts of the involucre essentially leaflike, the midvein not notably thickened, the inner pubescent, the outer pair glabrous on both surfaces or the upper surface infrequently puberulent; calyces canescent with short hairs in the upper parts, 3–5 mm. long, commonly 3.5–4 mm. long, the teeth deltoid, about .7 mm. long, not apiculate, acute or somewhat acuminate, hairy at the tip; corolla tube rather gradually enlarged upward, 2.3–4 mm. long, mostly about 3.5 mm., the upper lip 1.5–2.5 mm. tall; stamens exserted from the throat, sometimes minute and apparently nonfunctional.



Map 10. Distribution of *P. virginianum*.

Although it is true that the hairs of the stem are found wholly or chiefly along the angles, there is nevertheless a considerable variation in their appearance. Throughout the whole area of distribution infrequent specimens may be found in which the pubescence is spreading, the hairs being short, slender, and straight rather than curled, but not stiff. The following are representative of this type; many are otherwise typical of *P. virginianum,* but some have the sharper calyx teeth and velvety outer bracts of *P. verticillatum;* it may be, therefore, that some or all are hybrids with that species:

Knowlton (3. VIII. 1921), Burlington, Vt.; *Batchelder* (10. IX. 1910), Merrimack, N. H.; *Eggleston* 3057 (3. VIII. 1902), Mount Royal, Canada; *Bartram* (16. IX. 1917), Bushkill, Pa.; *Mackenzie* (25. VIII. 1912), Lakewood, N. J.; *Peters* (24. VII. 1888), Elwood, N. J.; *Rydberg* 1560 (14. VIII. 1893), S. Fork Dismal R., Nebr.; *Hitchcock* 794 (1896), Pottawatomie Co., Kan.; *Hasse* (19. VII. 1887), Desoto, Mo.; *Day* 134 (14. VII. 1898), Manchester, Vt.; *Clements* 2749 (19. VII. 1893), Pishelville, Nebr.; *Core* (14. VII. 1931), Glenlyn, Va.; *Core* (19. VIII. 1931), Wardensville, W. Va.; *Burnham* (20. VIII. 1907), Westbrook, N. Y.; *Meredith* (23. IX. 1921), Somerdale, N. J.; *Fernald* (25. VIII. 1908), Veazie, Me.; *Pease* (20. IX. 1924), Amherst, Mass.; *Vail* (7. VIII. 1891), Tannersville, N. Y.; *Hollick and Britton* (28. X. 1914), Staten Island, N. Y.; *Mackenzie* (12. VII. 1896), Rosedale, Kan.; *Clinton,* Buffalo, N. Y.

Associated with this type are rather numerous specimens in which the hairs appear more evenly on the sides of the stem and are commonly more abundant and often longer. Such specimens often have larger capitula and the calyx teeth are longer and more acute or even acuminate. It may be that such forms are hybrids with *P. pilosum,* either of this species or of *P. flexuosum* or both. They are close to *P. Torrei,* which see. They have been collected most abundantly in Missouri. The following are representative of this presumed hybrid:

Davis (16. VII. 1915), Oakwood, Mo.; *Bush* 354 (26. VII. 1896), Dodson, Mo.; *Standley* 8554 (31. VIII. 1911), Springfield, Mo.; *Mackenzie* (2. VIII. 1896), Little Blue, Mo.; *Bush* 32 (24. VII. 1891), Shannon Co., Mo.; *Hitchcock* (8. VII. 1890), Victoria, Mo.; *Davis* 3036 (4. VII. 1914), Hannibal, Mo.; *Bush* 298 (1. IX. 1899), Sibley, Mo.; *Palmer and Steyermark* 40786 (28. VI. 1933), Mexico, Mo.; *Trelease* 730 (11. IX. 1897), Club House, Mo.; *Kellogg* (13. VIII. 1884), Allenton, Mo.; *Steyermark* 1638 (22. VII. 1926), Forest Park, St. Louis, Mo.; *Kellogg* (20. VII. 1927), Grays Summit, Mo.; *Steyermark* 8560 (22. IX. 1922), Foley, Mo.; *Kellogg* (31. VII. 1927), Bloomsdale, Mo.; *Kellogg* (7. X. 1914), Jerome, Mo.; *Bush* (14. IX. 1893), Campbell, Mo.; *Bush* 7821 (6. X. 1916), Montier, Mo.; *Bush* 620 (28. IX. 1899), Swan, Mo.; *Kellogg* (4. VII. 1925), Hahns Mills, Mo.; *Plank* (1899), Benton Co., Ark.; *Patterson,* Oquawka, Ill.; *McDonald* (VII. 1894), Peoria, Ill.; *Bebb,* Marion Co., Ill.; *Friesner* 9751 (25. VII. 1936), Centerton, Ind.; *Deam* 17836 (22. VII. 1915), Lake Cicott, Ind.; *Murdock* (27. VII. 1900, VIII. 1900), Middleboro, Mass.

The second pubescence type consists of usually longer hairs which are ascendent along the angles or even appressed, and sometimes so dense as to be conspicuous to the naked eye. This type occurs principally in Wisconsin, Iowa, Illinois, Indiana, Michigan, and Ohio. It was this form which was described by Greene as *P. fascicularis.*

The third type, which occurs chiefly in the eastern coastal states, probably differs from the second only in degree and consists of smaller and upwardly curled hairs. These appear somewhat stiffer, perhaps, because they are shorter.

Other specimens are occasionally found, chiefly in Missouri, which have the habit of foliage of *P. flexuosum* but the heads and pubescence of *P. virginianum*. They may represent hybrids of these species or may represent simply an extreme condition of the latter. They are as follows:

Steyermark 12729, Hardage, Mo.; *E. J. Palmer* 31539, Lopez Switch, Mo.; *Steyermark* 19933, Munger, Mo.; *Steyermark* 13269, Jordan, Mo.; *Steyermark* 19776, Cherryville, Mo.; *Steyermark* 19793, Dillard, Mo.; *Eggert* (21. VIII. 1875), Forest Park, St. Louis, Mo.; *Eggert* (27. VII. 1892), Poplar Bluff, Mo.; *Trelease* 729, Cole Camp, Mo.; *Peterson* (14. VII. 1917), Jennings, Mo.; *Demaree* 3496, Bono, Ark.; *Merrill and Hagan* 755; 710, Platt National Park, Okla.; *Scovell and Clark* 1388, Lake Maxinkuckee, Ind.

Distribution (of form with short upwardly curled hairs).—CONNECTICUT. Fairfield, Hartford, Litchfield, New Haven, and New London counties. DELAWARE. Kent County. DISTRICT OF COLUMBIA. ILLINOIS. Adams, Champaign, Cook, Kane, and Stark counties. INDIANA. Carroll, Elkhart, Greene, Jefferson, and Porter counties. MAINE. Somerset County. MARYLAND. Allegany, Howard, and Queene Anne counties. MASSACHUSETTS. Barnstable, Berkshire, Duke, Essex, Hampden, Nantucket, and Plymouth counties. MICHIGAN. St. Clair and Washtenaw counties. MISSOURI. Jasper County. NEW HAMPSHIRE. Cheshire County. NEW JERSEY. Bergen, Camden, Essex, Mercer, Middlesex, Morris, Ocean, Passaic, Somerset, Sussex, and Warren counties. NEW YORK. Bronx, Chemung, Dutchess, Herkimer, Nassau, New York, Ontario, Orange, Putman, Richmond, Suffolk, and Westchester counties. OHIO. Clark County. PENNSYLVANIA. Bucks, Butler, Chester, Lehigh, Luzerne, Monroe, Northampton, and Philadelphia counties. RHODE ISLAND. Providence and Washington counties. VERMONT. Bennington and Rutland counties. VIRGINIA. Rockingham and Sussex counties. WEST VIRGINIA. Greenbrier and Hardy counties. WISCONSIN. Iowa County.

(Form with longer ascendent hairs): CANADA. Sainte-Genevieve.

CONNECTICUT. Litchfield and Windham counties. ILLINOIS. Cass, Champaign, Cook, Du Page, Hancock, Henry, Iroquois, Jo Daviess, Kane, Kankakee, Lake, Lee, McLean, Peoria, Rock Island, Stark, and Winnebago counties. INDIANA. Allen, Clinton, Decatur, Delaware, Elkhart, Fulton, Lake, Marshall, Newton, Porter, Steuben, Tipton, and Wayne counties. IOWA. Benton, Black Hawk, Cerro Gordo, Fayette, Hardin, Jackson, Kossuth, Scott, Story, and Winneshiek counties. KANSAS. Cherokee and Shawnee counties. MASSACHUSETTS. Hampshire, Middlesex, and Norfolk counties. MINNESOTA. Chisago, Clay, Hennepin, Kandiyohi, Polk, and Winona counties. MISSOURI. Audrain, Iron, Jackson, Jefferson, Polk, Ralls, Ripley, and St. Louis counties. NEBRASKA. Brown, Kearney, Knox, and Redwillow counties. NEW JERSEY. Camden, Cape, Morris, and Sussex counties. NEW YORK. Madison, Ontario, Washington, and Westchester counties. NORTH CAROLINA. Buncombe County. OHIO. Champaign, Franklin, Hamilton, Highland, Lucas, and Ross counties. OKLAHOMA. Murray County. PENNSYLVANIA. Blair, Chester, Delaware, Erie, Lawrence, and Philadelphia counties. TENNESSEE. Cocke, Knox, and Loudon counties. VERMONT. Bennington and Rutland counties. VIRGINIA. Montgomery and Pulaski counties. WISCONSIN. Brown, Buffalo, Columbia, Crawford, Dane, Dunn, Grant, Green Lake, Iowa, Jefferson, Juneau, Lafayette, Marquette, Milwaukee, Pierce, Polk, Racine, Richland, Sauk, Trempealeau, Vernon, Walworth, Washington, Waukesha, and Waushara counties.

17. **P. flexuosum** Britton, Stearns, and Pogg.

P. flexuosum Britton, Stearns, and Pogg., Prelim. Cat. N. Y. Pl. 42, 1888.

Satureja virginiana L., Sp. Pl. 567, 1753, in part; see discussion under *P. virginianum*.

Origanum flexuosum Walt., Fl. Carolin. 165, 1788; there are no specimens of this species among the Walter plants in the British Museum; *P. aristatum* is represented, however.

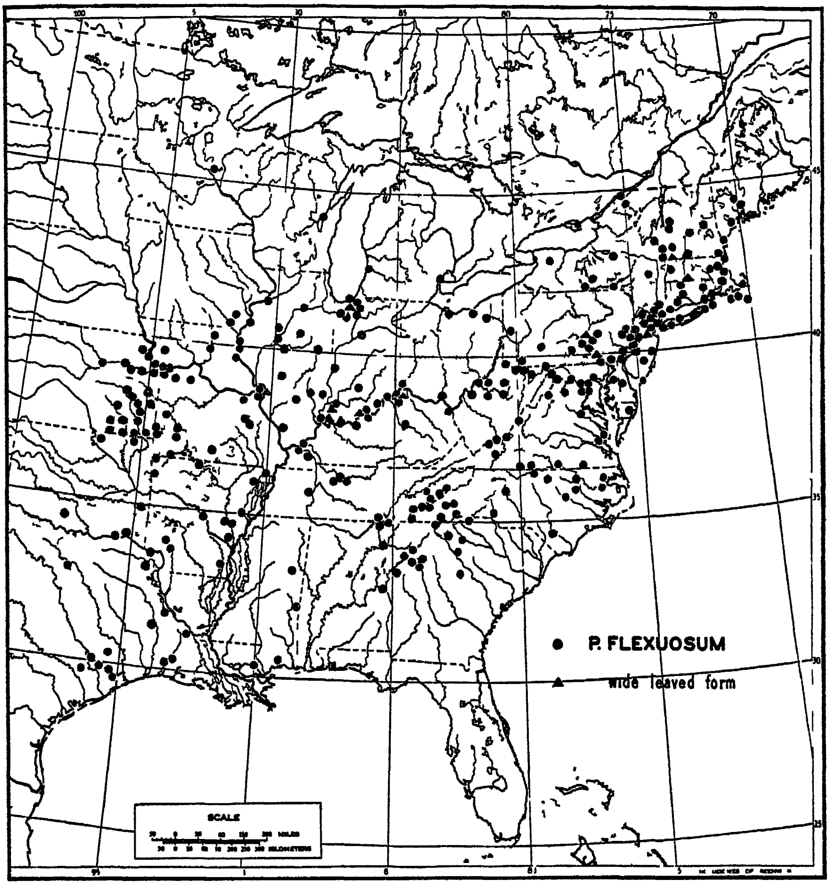
Koellia capitata, Moench, Meth. 408, 1794.

K. flexuosa McMill., Metasp. Minn. Valley 452, 1892.

Brachystemum linifolium Willd., Enum. Hort. Berol. 623, 1809; a specimen is preserved in the Willdenow herbarium; it is as usually interpreted.

Pycnanthemum linifolium Pursh, Fl. Amer. Sept. 2: 409, 1814.
P. tenuifolium Schrad., Hort. Goett. 10, 1809; the type is apparently not preserved in the herbarium of the University of Goettingen.

Perennial herbs as much as a meter tall, commonly about 60 cm., bearing short leafy lateral branchlets in the upper parts, the median internodes longer than the subtending leaves, or equal, those of the lateral branches much shorter, glabrous, or very rarely with a few minute hairs curled upward along the angles; leaf blades linear, sessile, entire, the median 22–57 mm. long, commonly about 40 mm., 1.5–5.5 mm. broad, usually about 3 mm., with one or two pairs of lateral veins arising near the base; glomerules solitary and terminal, disposed in rather compact corymbs, the bracts of the involucre scarcely foliar, apiculate or subspinose, the midrib conspicuously thickened; calyces canescent with short hairs in the upper part, even annulate at the base of the teeth, 4–5 mm. long, the teeth apiculate or subspinose, glabrate, hirtellous within, about 1–2 mm. long; corolla tube 3–4.5 mm. long, pubescent within the throat, rather abruptly enlarged at the throat, the upper lip 2–2.5 mm. tall.



Map 11. Distribution of *P. flexuosum*.

This species is one of the most stable and, except for a few specimens which may represent hybrids, either with *P. pilosum* or *P. virginianum* (see note under the latter species), is readily distinguished by the glabrous stems, the type of leaf venation, and small capitula in which the outer bracts have a markedly thickened midvein. A few specimens have been observed in which there is a slight upwardly curled pubescence on the upper part of the stems. The plants are otherwise typical. These are as follows:

Marble (IX. 1909), Bedford, N. Y.; *Phelps* (17. VIII. 1915), Norfolk, N. Y.; *Ferguson* (18. VII. 1925), Long Island, N. Y.; *Eggleston* (17. VII. 1898), Hubbardton, Vt.; *Eggleston* (6. IX. 1897), W. Pownal, Vt.; *Dutton* (19. VIII. 1922), Brandon, Vt.; *Kennedy* (12. VII. 1894), Hyde Park, Mass.; *A. A. Eaton* (1898), Salisbury, Mass.; *Cushman* (12. VIII. 1912), Falmouth, Mass.; *Seymour* (6. IX. 1917), West Tisbury, Mass.; *Woodward* (12. VII. 1899), Franklin, Conn.; *Benner, Long and Bassett* (10. VIII. 1926), Atsion, N. J.; *Long* (25. VII. 1926), Somerton, Pa.; *Benner* (16. VII. 1926), Philadelphia, Pa.; *Johnson* (26. VII. 1914), Dune Park, Ind.; *Young* (VII. 1876), Hanover, Ind.; *Robinson* (31. VIII. 1904), Hendrix, Ill.; *Seymour* (8. VII. 1874), Springfield Junction, Ill.; *Ridgway* (7. VIII. 1917), Olney, Ill.; *Bush* 449 (22. VII. 1896), Little Blue, Mo.; *House* (5. VIII. 1909), Avery Creek Valley, N. C.

A few specimens have wider leaves suggesting those of *P. virginianum*. These occur chiefly along the Ohio River in Indiana. However, see a note under *P. virginianum*.

Distribution.—ALABAMA. Etowah and Lee counties. ARKANSAS. Arkansas, Benton, Craighead, Drew, Marion, Monroe, Nevada, Pike, Prairie, Pulaski, St. Francis, and Washington counties. CONNECTICUT. Fairfield, Hartford, New Haven, and New London counties. DELAWARE. Kent and New Castle counties. DISTRICT OF COLUMBIA. GEORGIA. Cobb, Coweta, DeKalb, Floyd, McDuffie, Oconee, Rabun, Walker, and Whitfield counties. ILLINOIS. Adams, Champaign, Clay, Henderson, Jackson, La Salle, Marion, Mason, Massac, McLean, Menard, Montgomery, Peoria, Richland, Rock Island, Stark, and Union counties. INDIANA. Brown, Cass, Clark, Crawford, Dearborn, Gibson, Harrison, Jasper, Jefferson, La Porte, Pike, Porter, Posey, Spencer, Starke, Switzerland, Vanderburgh, and Vigo counties. IOWA. Henry and Van Buren counties. KANSAS. Anderson, Atchison, Bourbon, Chatauqua, Cherokee, Coffey, Crawford, Douglas, Elk, Franklin, Greenwood, Johnson, Labette, Leavenworth, Linn, Montgomery, Riley, Shawnee, Wilson, Woodson, and Wyandotte counties. KENTUCKY. Boyd, Breckenridge, Fayette, Marshall, and McCracken counties. LOUISIANA. Calcasieu, Jefferson Davis, Natchitoches, Rapides, and St. Tammany parishes. MAINE. Cumberland, Franklin, Kennebec, and York counties. MARYLAND. Allegany, Biltmore, Garrett, Harford, Kent, Montgomery, Prince Georges, and Worcester counties. MASSACHUSETTS. Berkshire, Bristol, Dukes, Essex, Hampden, Middlesex, Nantucket, Norfolk, Plymouth, Suffolk, and Yarmouth counties. MICHIGAN. Allegany and Wayne counties. MINNESOTA. Anoka County. MISSISSIPPI. Clarke, Harrison and Oktibbeha counties. MISSOURI. Adair, Barry, Clinton, Franklin, Greene, Iron, Jackson, Jasper, Macon, Pike, Polk, Ralls, Shannon, St. Clair, and St. Louis counties. NEW HAMPSHIRE. Cheshire and Grafton. NEW JERSEY. Bergen, Burlington, Cape May, Essex, Hunterdon, Middlesex, Monmouth, Morris, Ocean, Somerset, and Union counties. NEW YORK. Broome, Genesee, Greene, Nassau, Oneida, Queens, Rensselaer, Richland, Saratoga, St. Lawrence, Suffolk, Tioga, Tompkins, Washington, and Westchester counties. NORTH CAROLINA. Bladen, Buncombe, Chowan, Clay, Davie, Durham, Edgecombe, Haywood, Henderson, Jackson, Polk, Rockingham, Swain, Wake, and Washington counties. OHIO. Cuyahoga, Erie, Hamilton, Portage, and Scioto counties. OKLAHOMA. Choctaw, Craig, Le Flore, McCurtain, Osage, and Stephens counties. PENNSYLVANIA. Armstrong, Berks, Bucks, Cambria, Chester, Delaware, Fayette, Greene, Lancaster, Lehigh, Montgomery, Northampton, Perry, Philadelphia, Schuylkill, and York counties. SOUTH CAROLINA. Abbeville, Anderson, Cherokee, and Laurens counties. TENNESSEE. Blount, Cheatham, Davidson, Decatur, Dickson, Greene, Hamilton, Knox, and Monroe counties. TEXAS.

Austin, Bowie, Cass, Colorado, Dallas, Harris, Montgomery, Newton, and Walker counties. VERMONT. Addison, Bennington, and Rutland counties. VIRGINIA. Arlington, Bath, Caroline, Fairfax, Frederick, Giles, Gloucester, Greenville, Henry, James City, Loudon, Mecklenburg, Pittsylvania, Pulaski, and Shenandoah counties. WEST VIRGINIA. Cabell, Calhoun, Hampshire, Harrison, Mercer, Monongalia, Monroe, Preston, Ritchie, Summers, Upshur, Wirt, and Wood counties. WISCONSIN. Calumet County.

18. **P. muticum** Pers.

P. muticum Pers., Syn. Pl. 2: 128, 1807.

Brachystemon muticum Michx., Fl. Bor. Amer. 2: 6, pl. 32, 1803; the specimen in the Michaux herbarium is glabrous and has somewhat shining leaves with prominent veins.

P. arkansanum Fresen., Flora 25: 325, 1842, based upon a specimen collected by Engelmann in Arkansas; an isotype is in the herbarium of the Missouri Botanical Garden.

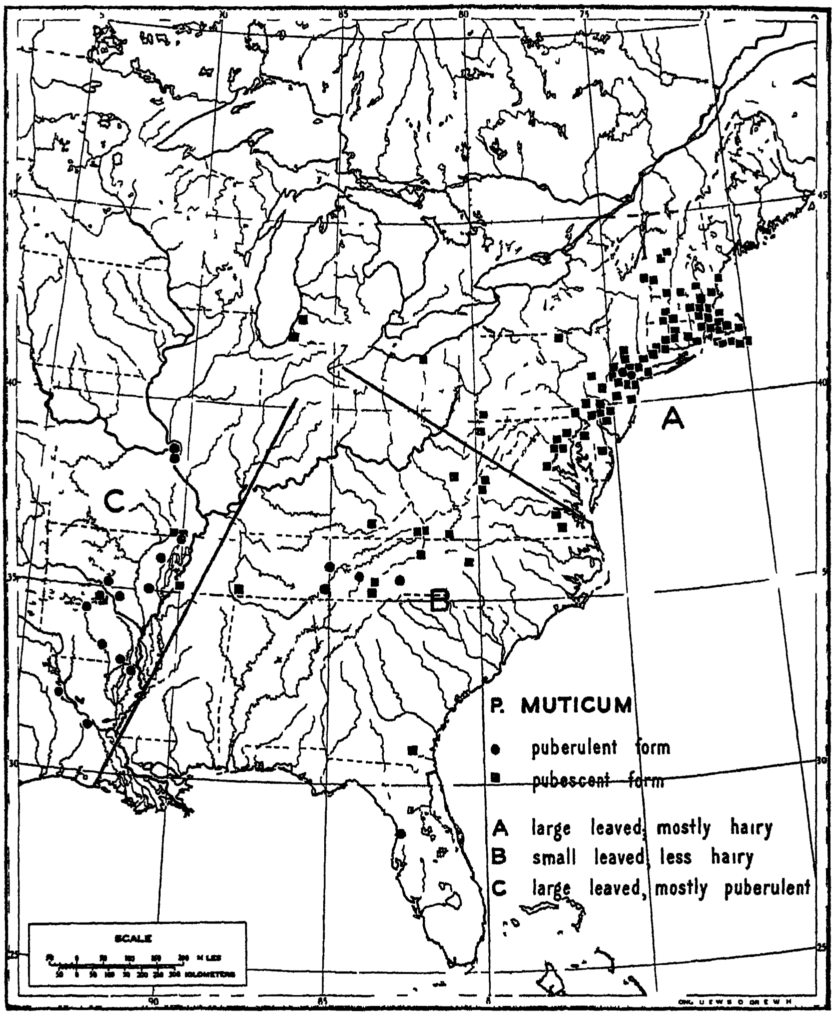
P. ovatum Nutt. ex Benth., DC. Prodr. 12: 188, 1848; the specimens at Kew to which Bentham perhaps referred are referable to this species.

Koellia mutica Britton ex Small and Vail, Bull. Torr. Bot. Cl. 4: 145, 1893.

Perennial herbs as much as 110 cm. tall, commonly 60–70 cm., branching chiefly in the inflorescence, simple below or with a few weak lateral branches, the median internodes somewhat longer than the subtending leaves, or shorter, rarely twice as long, pubescent with decurved hairs, or these rarely spreading; leaf blades ovate-lanceolate, or narrowly ovate, the largest usually median, 2.5–8 cm. long, usually about 5 cm., 1.5–3.5 cm. broad, acuminate, rounded at the base, bearing 5–6 pairs of lateral veins or more, the intermediate veins apparent, all tending to anastomose, the upper surfaces glabrous, the lower glabrous or pubescent along the veins, especially the midvein, shallowly serrate, or rarely entire, essentially sessile; glomerules solitary and terminal or occasionally 2, subtended by diminished leaflike but canescent velvety bracts; calyces closely pubescent in the upper parts, 3–5 mm. long, commonly about 3.5 mm., the teeth narrowly deltoid, somewhat acuminate but scarcely apiculate, .5–1 mm. long, usually about .7 mm., essentially equal; corolla tube gradually enlarged upward, 3–3.5 mm. long, the upper lip 1.5–2 mm. tall; stamens sometimes normal and about equaling the corolla in length, more frequently minute, scarcely exserted from the throat, apparently nonfunctional.

The principal variation within this species is found in leaf form and pubescence, both of the stems and leaves. The predominant tendency is for the leaves to be ovate or ovate-lanceolate, the largest or median ones being usually about 5 cm. long. With this larger-leaved, broader-leaved form is usually associated a longer, more copious stem pubescence of much the same type of hair as is found on the calyces and bracts, tending to spread or be decurved. However, the leaves of this form may be hirtellous along the veins beneath, or glabrate. The glabrous leaves are usually smaller in size, commonly not over 4 cm. at the maximum. The larger-leaved, more pubescent types seem to occur more abundantly in New England than elsewhere. In this pubescence type occasional forms occur, however, in which the leaves are small and elliptical, being sometimes not more than 1.5 cm. broad. Such forms lie close to *P. virginianum*. The calyces of this pubescence form are slightly larger, averaging about 3.7 mm.

Throughout most of the area of occurrence, but chiefly confined to Arkansas and Missouri, is a form in which the pubescence is minute and dense, appearing absent to the naked eye. In the uppermost part of the inflorescence the hairs may be seen to spread or be somewhat directed upward. This pubescence is about of the same order as that of *P. aristatum*. The leaves, however, are uniformly large, being commonly 5–8 cm. long, and 2.5–3 cm. broad. They are usually ovate. The calyces are somewhat smaller, being about 3.3 mm. long on the average. It was this form which was named *P. arkansanum*. It may be determined by more intensive study than is possible with the herbarium method that three principal subspecific categories exist. These are suggested on Map 12. The leaf habit, particularly with reference to venation, is suggestive of *P. californicum*.


A
B
C
P. MUTICUM
● puberulent form
■ pubescent form
A large leaved, mostly hairy
B small leaved, less hairy
C large leaved, mostly puberulent
SCALE
MILES
KILOMETERS

Map 12. Distribution of *P. muticum*.

Distribution (of pubescent form).—ARKANSAS. Pulaski County. CONNECTICUT. Fairfield, Hartford, New Haven, and New London counties. DELAWARE. New Castle and Sussex counties. DISTRICT OF COLUMBIA. GEORGIA. Charlton County. KENTUCKY. Knox County. MARYLAND. Baltimore, Kent, and Prince Georges counties. MASSACHUSETTS. Barnstable, Berkshire, Bristol, Dukes, Essex, Hampden, Hampshire, Middlesex, Nantucket, Norfolk, and Plymouth counties. MICHIGAN. Berrien and Ottawa counties. MISSOURI. Butler and Dunklin counties. NEW HAMPSHIRE. Cheshire and Hillsborough counties. NEW JERSEY. Bergen, Essex, Gloucester, Hudson, Hunterdon, Middlesex, Ocean, Passaic, Salem, Somerset, Sussex, and Warren counties. NEW YORK. Orange, Richmond, Suffolk, and Washington counties. NORTH CAROLINA. Avery, Forsyth, Jackson, and Swain counties. OHIO. Cuyahoga County. PENNSYLVANIA. Bradford, Bucks, Delaware, Fayette, Lancaster, Lehigh, Northampton, and York counties. RHODE ISLAND. Kent, Providence, and Washington counties. TENNESSEE. Hardin and Shelby counties. VERMONT. Bennington, Windham, and Windsor counties. WEST VIRGINIA. Preston and Webster counties.

(Puberulent form): ARKANSAS. Ashley, Calhoun, Craighead, Faulkner, Garland, Lonoke, Pulaski, and Saline counties. FLORIDA. Hernando County: Brooksville. LOUISIANA. Rapides, Red River, and West Carroll parishes. MISSOURI. Butler, Dunklin, and St. Louis counties. NEW JERSEY. Bergen and Passaic counties. NEW YORK. Richmond County. NORTH CAROLINA. Buncombe County. TENNESSEE. Blount, Cumberland, and Hamilton counties.

19. **P. aristatum** Michx.

P. aristatum Michx., Fl. Bor. Amer. 2: 8, pl. 33, 1803; the specimen in the Michaux herbarium at Paris is similar to one collected by Torrey and Gray at Portsmouth in July, 1840.

P. setosum Nutt., Jour. Acad. Philad. 7: 100, 1834, based upon a specimen collected by Nuttall, probably in Maryland; authentic material is in the herbarium of the Academy of Natural Sciences of Philadelphia.

Koellia aristata Kuntze, Rev. Gen. 2: 520, 1891.

Perennial herbs as much as 80 cm. tall, commonly about 50 cm., their stems branching rather loosely in the upper parts, simple below or occasionally with short lateral branchlets in the axils of the leaves; the median internodes somewhat longer than the subtending leaves, rarely twice as long, puberulent with minute spreading or somewhat decurved hairs; leaf blades narrowly ovate, infrequently ovate-lanceolate, usually rather acute, the median leaves with 5–7 pairs of lateral veins, commonly 6, 2.5–6 cm. long, usually about 4 cm., 1–3 cm. broad, entire or a few serrate, glabrate, the median petioles 1–2 mm. long; glomerules rather loose, terminal and solitary or occasionally two, disposed in irregular leafy corymbs, subtended by leaflike, velvety canescent bracts, the inner linear and subaristate; calyces minutely puberulent, 5–6 mm. long, commonly about 5.5 mm., costate, teeth shortly aristate and rigid, puberulent, 1.3–2.2 mm. long, commonly 1.8 mm.; corolla tubes gradually enlarged upward, 4.5 mm. long, the upper lip 2–3 mm. tall; nutlets hairy at the apex.

This species seems to be quite stable and distinct. The upper and lower calyx teeth are about the same length in relation to the length of the calyx, while those of *P. hyssopifolium* vary somewhat. The larger leaved forms resemble *P. muticum* in habit.

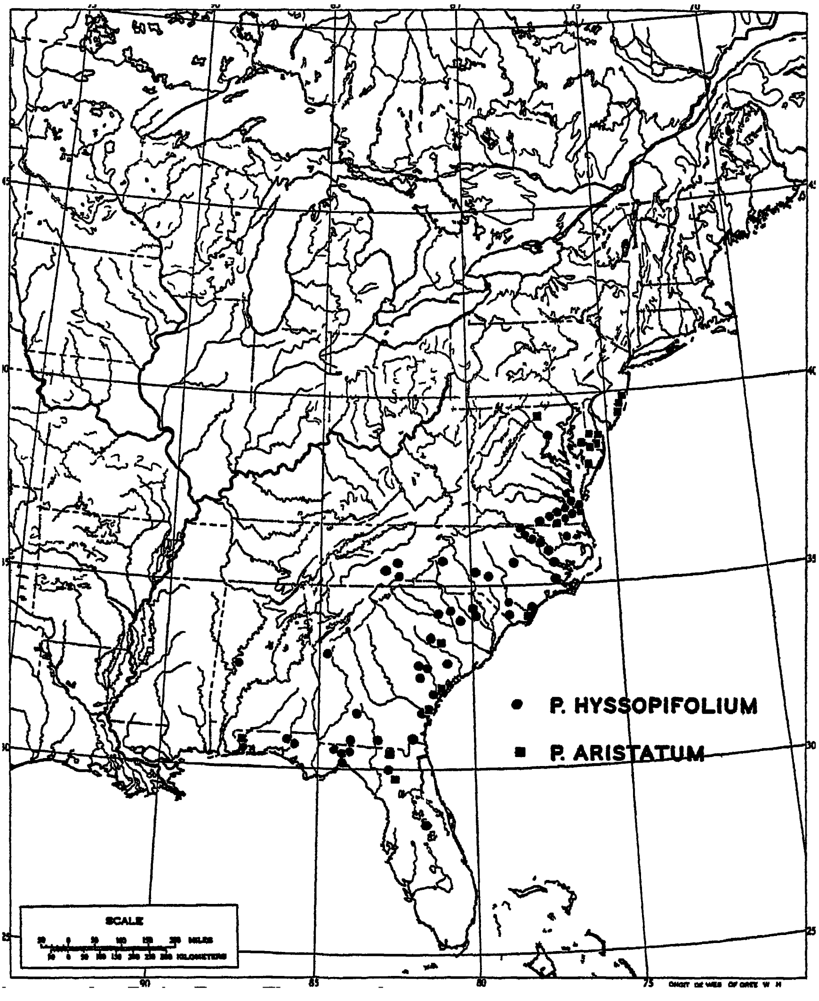
Distribution.—DELAWARE. Kent and Sussex counties. FLORIDA. Alachua, Calhoun, and Columbia counties. GEORGIA. Bryan and McIntosh counties. MARYLAND. Caroline, Frederick, Somerset, and Worcester counties. NEW JERSEY. Atlantic and Ocean counties. NORTH CAROLINA. Beaufort and Orangeburg counties. VIRGINIA. Greensville and Norfolk counties.

20. **P. hyssopifolium** Benth.

P. hyssopifolium Benth., Lab. Gen. et Sp. 329, (Apr.) 1834.

P. aristatum Pursh, Fl. Amer. Sept. 2: 409, 1814 (not Michaux 1803); two specimens mounted on one sheet are in the Hooker herbarium and are doubtless the specimens referred to by Bentham, loc. cit., as those seen in the Lambert Herbarium by him; a similar and more ample specimen is preserved among the Pursh plants at Philadelphia. Bentham referred to Pursh's name decisively as a synonym of his name *P. hyssopifolium* and cited therewith a Bosc specimen received from Moretti in 1834, a collection in the

Hooker herbarium made by Darlington at Norfolk, Va., in 1831, one received from Torrey which is not in the Bentham herbarium today but may have been a specimen sent by Le Conte which is now in the Torrey herbarium, and a specimen in the Bentham herbarium collected by Drummond in Louisiana. Since Bentham, in a footnote, cast doubt upon the inclusion of the Darlington and Drummond specimens in his newly proposed



Map 13. Distribution of *P. hyssopifolium* and *P. aristatum.*

species, it would seem that the choice of a standard for *P. hyssopifolium* would lie with either the Bosc or Pursh collections. The only ones for which a specific locality is known are the Pursh specimens from Southampton, Va.; they are accordingly suggested as the standards both for Pursh's name and for Bentham's new name *P. hyssopifolium.* All of these specimens are conspecific with Clayton 898, which has been suggested as the standard of *Nepeta virginica* L., Sp. Pl. 571, 1753, as well as with the specimens of the Morison herbarium referred to by Vines and Druce and the Plukenet specimen (see Epling, Jour. of Botany, Jan., 1929, p. 8).

P. aristatum var. *hyssopifolium* Gray, Syn. Fl. N. Amer. 2: 354, 1878.
Koellia virginica Farwell in Papers Mich. Acad. Sci. 2: 37, 1923.

K. hyssopifolia Britton, Mem. Torr. Bot. Cl. 5: 279, 1894.
K. Hugeri Small, Fl. SE. U. S. 1047, 1337, 1903; type collected by *A. W. Huger* in North Carolina in woods near Hendersonville (N. Y. Bot. Gard.).

Perennial herbs as much as 150 cm. tall, commonly 60–70 cm., their stems branching freely in the inflorescence or rarely simple, commonly with short lateral branches in the axils of the leaves; median internodes about twice as long as the subtending leaves, or shorter, puberulent with minute spreading hairs, and directed slightly upward, appearing glabrous; leaf blades linear to elliptic, widest near but below the middle and more or less equally narrowed in both directions, usually rounded at the tip, bearing usually 3 or 4, rarely 5 pairs of simple lateral veins, the uppermost of which arise near the middle or below and extend to the apex, the median 2.5–5.5 cm. long, usually about 3.5 cm., .6–1.5 cm. broad, commonly entire, or the larger shallowly serrate, puberulent with minute spreading hairs on both surfaces, the median petioles 1–2 mm. long; glomerules rather loose, the branches usually appparent, terminal and solitary or very rarely two, disposed in irregular corymbs 8–15 cm. broad, the outer bracts subfoliar, reflexed, usually shorter than the calyces, the inner aristate; calyces minutely puberulent, 5–8.8 mm. long, commonly about 6.8 mm., costate, the teeth aristate and rigid, puberulent, 2.3–4.8 mm. long, commonly about 3 mm.; corolla tube gradually enlarged upward, 4.5–7 mm. long, pubescent within the throat, the upper lip 2.5–3 mm. tall; nutlets hairy at the apex.

A few specimens show a tendency toward serration of the leaves combined with calyces in which the upper teeth are connate at the base and have loose capitula. The most noteworthy of these are Floridan:

Washington County, *Mohr;* Lake City, Columbia County, *Nash* 2182; Dead Lakes, Calhoun County, *Chapman;* Westville, Holmes County, *Biltmore Herb.* 5728*a;* Sanford, Orange County, *Nash* 2259.

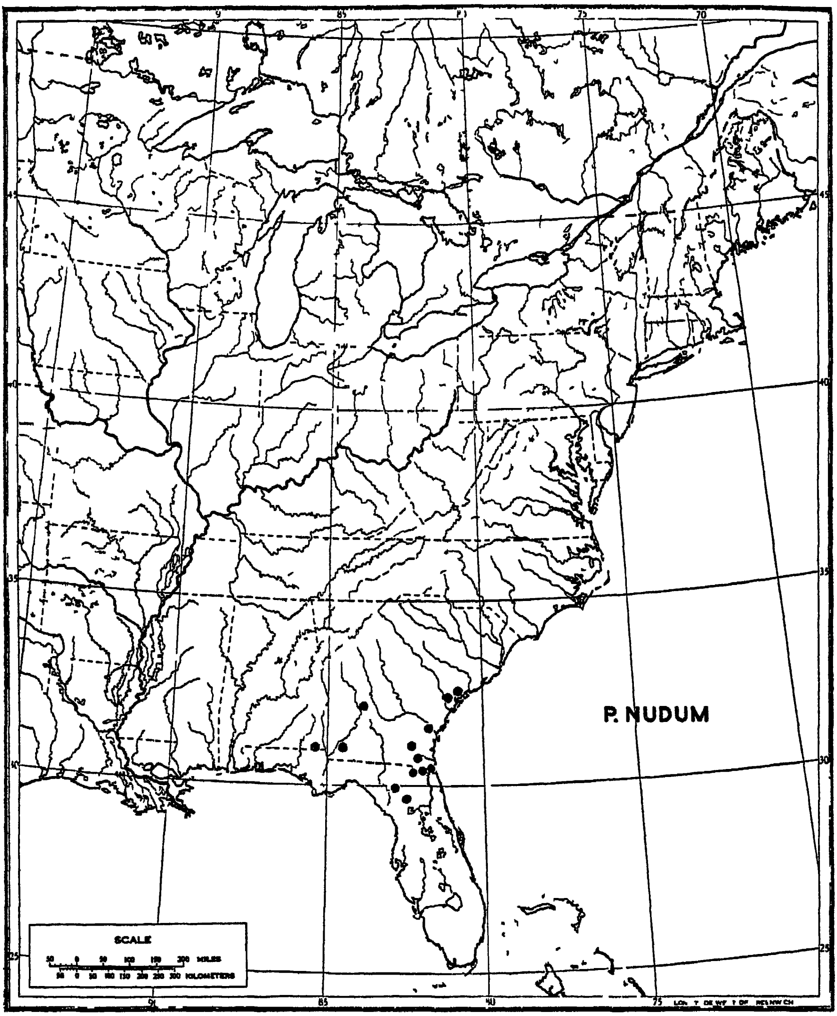
Within the species the calyces are fairly constant although the upper or lower teeth may be the longer. This variation in length in relation to the upper and lower teeth may occur in the same flower head. There is a continuous variation from the shorter to the longer calyx teeth. Small described the longer forms as *P. Hugeri.* They are not confined to the mountains of North Carolina as he believed.

Distribution.—ALABAMA. Hale County. DISTRICT OF COLUMBIA. FLORIDA. Calhoun, Columbia, Gadsden, Holmes, Jefferson, Leon, Orange, Taylor, Wakulla, and Washington counties. GEORGIA. Bullock, Bryan, Charlton, Jenkins, Lowndes, McIntosh, Meriwether, Screven, Thomas, and Worth counties. NORTH CAROLINA. Beaufort, Bladen, Buncombe, Chowan, Columbus, Craven, Halifax, Haywood, Henderson, Iredell, Martin, Montgomery, Moore, New Hanover, and Wayne counties. SOUTH CAROLINA. Colleton, Darlington, Florence, Kershaw, Lexington, Richland, and Sumter counties. VIRGINIA. Elizabeth City, Isle of Wight, Nansemond, Norfolk, Princess Anne, Southampton, and Sussex counties.

21. **P. nudum** Nutt.

P. nudum Nutt., Gen. Amer. Pl. 2: 34, 1818, based upon specimens collected in the mountains of Carolina and Georgia; the type or standard, collected in Georgia, and now in the British Museum of Natural History, is very like *Harper* 680, collected in Coffee County, Georgia; similar Nuttall specimens are in the herbarium of the Academy of Natural Sciences at Philadelphia.
K. nuda Kuntze, Rev. Gen. 2: 520, 1891.

Perennial glabrous herbs punctate throughout with sessile glands, as much as 75 cm. tall, commonly 50–60 cm., their stems simple and virgate, usually branched only in the inflorescence, the median internodes commonly equal to or shorter than the subtending leaves, the lower and upper ones longer, those of the inflorescence frequently elongate; leaf blades leathery, sessile, ovate, oval or elliptical, rather obtuse at the apex, essentially entire but sometimes shallowly toothed in the upper part, the largest occurring near the middle of the stem or below, 1–3 cm. long, usually about 2 cm., .5–1.5 cm. broad, gradually diminished upward, all, even of the inflorescence, bearing two, or more commonly, 3 pairs of lateral veins, the uppermost pair of which arises near the middle of the leaf and extends to the tip; inflorescence a narrow corymb, the leaves of which are much reduced, each peduncle producing 1–3 glomerules at the apex; outer bracts leaflike but usually with only 1 vein; calyces glabrous except for a margin of hairs along the teeth, glandular-punctate, 3.5–5 mm. long, commonly 3.5–4 mm., the teeth 1 mm. long or less, narrowly deltoid, herbaceous, the posterior three connate at the base and somewhat shorter; corolla tube 4.5–6 mm. long, hairy within the throat, abruptly funnelform above the middle, the upper lip 2.5–3 mm. tall.



Map 14. Distribution of *P. nudum*.

This is a morphologically distinct species and is quite stable. The leaves may be ovate, oval, or elliptical; they are rarely shallowly toothed. The calyx teeth vary slightly in length and may have a few hairs on the edges or may be heavily fringed or ciliate.

Distribution.—ALABAMA. Dale County. FLORIDA. Alachua, Columbia, and Duval counties. GEORGIA. Bryan, Charlton, Coffee, Ware, Wayne, and Worth counties. SOUTH CAROLINA. Beaufort and Jasper counties.

UNCERTAIN FORMS AND PUTATIVE HYBRIDS

These are the principal facts of interspecific relationship obtained from a study of herbarium specimens. Numerous examples can be found in the herbarium which do not conform exactly to the species as outlined here. Further study may show that many of these, rather than being ephemeral, have become established locally by asexual means and, upon better acquaintance may take on as much reality as *P. Beadlei,* for example. The most striking examples of possible hybrids or other aberrent and intermediate forms which have been met with in this study are listed below. It is hoped that their citation may assist in a more intensive study on the part of botanists who live in the regions concerned.

1. *P. leptodon* Gray, Syn. Fl. N. Amer. 2: 355, 1878; type collected in Ashe County, N. C. by Gray and Carey (Gray Herb.). *P. pilosum* var. *leptodon* Gray in Amer. Jour. Sci. 42: 46, 1842. *Koellia leptodon* Kuntze, Rev. Gen. 2: 520, 1891.

This uncertain form may represent a hybrid or a polyploid form of similar derivation to *P. Torrei,* but of more southerly distribution. Its inflorescence, flowers, and pubescence are similar to that species. The pubescence of the stem, however, is generally longer and somewhat coarser and the leaves more nearly suggest those of *P. virginianum* in texture. In habit and pubescence it resembles those forms of *P. virginianum* which have spreading pubescence. The inner bracts and calyx teeth are tapering and subspinose. The following specimens may be associated with the type:

WEST VIRGINIA. Summers County: Hinton (12. VIII. 1891, *Millspaugh* 1125, NYBG). Fayette: 1898 (*Nuttall* 1630, W. Va.). NORTH CAROLINA. Orange: open pine woods, 4 miles west of Chapel Hill (28. VI. 1927, *Wiegand and Manning* 2766, GH). Ashe: (1841, *Gray and Carey,* GH, NYBG, ASP, K).

Similar specimens, scarcely referable elsewhere, but with a minute spreading pubescence on the stems, have been collected as follows:

NORTH CAROLINA. Slopes of Kings Mountain (July 1896, *Small,* NYBG).

2. Collected with *P. leptodon* was a form characterized by Gray as a narrow-leaved form of *P. Tullia* and later published as *P. dubium* Gray in Amer. Jour. Sci. 42: 45, 1842, and *P. Tullia* var. *dubium* Gray, Syn. Fl. 2: 355, 1878, and *Koellia dubia* Briq. in Engler u. Prantl, Die Nat. Pflanzenf. IV, 3*a*. 310, 1896.

This form most nearly resembles *P. clinopodioides,* particularly in the fuzzy capitula. However, the calyx teeth strongly resemble those of *P. Tullia,* as pointed out by Gray, and as he suggests, the form may be a hybrid of *P. Tullia* and some other narrow-leaved species, perhaps *P. virginianum.* The only other specimen which is strictly comparable to the type collection was one made by Gray at the same place (presumably), that is, Jefferson, Ashe County, two years later. However, other specimens resemble *P. dubium* in habit, in the fuzzy capitula, and the spreading pubescence, but the calyx teeth, while tapering, are not as rigid and do not suggest those of *P. Tullia.* The capitula are more dense and more suggestive of those of *P. leptodon* except for the pubescence. These may represent hybrids of *P. pilosum,* with which some member of the *incanum* group is intermixed. They are as follows:

PENNSYLVANIA. Mercersburg (4. VIII. 1845, *Detwiller* (ASP). OHIO. Springfield (*Sullivant* GH). NEBRASKA. Crawford (13. VIII. 1896, *Plank* NYBG). MISSOURI. Atherton (1. VIII. 1902, *Mackenzie* 85, NYBG).

3. The following are similar to *P. dubium* in general aspect, have rather loose capitula which bear numerous bristles, and, while the calyx teeth suggest those of *P. Tullia,* the leaves are firm and serrate, in contrast to those, more lax and entire, of *P. dubium.* As suggested by Gray in a herbarium note, they may represent a hybrid of *P. montanum* and *P. Tullia* or a similar form.

NORTH CAROLINA. Table Rock (1878, *Vasey* GH, USNH); Tuckaseegee Falls (7. VII. 1935, *Oosting* 35413, W. Va.); same (13. VII. 1933, *Blomquist* ASP); Frying Pan Gap and Big Boulder (25. VII. 1925, *Rydberg* 9503, UC, NYBG); Summit, Satoola Mountain, Macon County (30. VIII. 1882, *J. D. Smith* MBG).

4. The following are similar to *P. Beadlei* in most respects, but have leaves which taper to the base, and median petioles which are as much as 8 mm. long. In this respect they more nearly suggest *P. montanum* but have hairy stems and firm leaves.

NORTH CAROLINA. Transylvania: Pink beds (6. VII. 1909, *House* 4357, USNH); Asheville (1. IX. 1893, *Robinson* 25, GH).

5. *Koellia pauciflora* Small, Man. Southeastern Flora, 1174, 1933; the type was collected along the Flinthaven at Albany, Georgia (9–12. VII. 1895, NYBG).

This proposed species is distinguished from *P. albescens* only by the narrowly deltoid calyx teeth, which are like those of *P. floridanum.*

6. Allied here but not wholly comparable are several specimens from western Florida. In calyx teeth they suggest *P. Loomisii.*

FLORIDA. Near Tallahassee (*Berg* NYBG); near River Junction (8. IX. 1897, *Curtiss* 5981, GH, US, NYBG, UC); near Aspalaga, with typical *P. albescens* (X. 1897, *Biltmore Herb.* 747*c*, NYBG).

7. The following specimens strongly suggest a hybrid between *P. hyssopifolium* and *P. Tullia* or an allied form:

VIRGINIA. Homeville (20. VII. 1936, *Fernald and Long* 6580, GH); Kilby (11. IX. 1935, *Fernald* et al. 5023, 5024, 5025, GH); Great Bridge (11. IX. 1935, *Fernald* et al. 5021, GH, US).

8. An anomalous form which may be a hybrid of *P. muticum* and *P. pilosum* or *P. verticillatum* occurs sporadically throughout the range of these species. The calyx teeth are narrowly deltoid and usually bear a few shortish bristles.

In this respect they suggest *P. clinopodioides*. The stem pubescence is variable but spreading, suggesting that of *P. pilosum*. The texture and venation of the leaves suggest *P. muticum*. Although *P. pilosum* occurs chiefly west of Ohio, typical specimens have been gathered in Monroe County, Pennsylvania, and in Windham County, Connecticut. Following is the distribution of these putative hybrids:

ARKANSAS. Little Rock (X. 1886, *Hasse* USNH, NYBG); a second collection by Hasse at Little Rock (VII. 1885) suggests a hybrid of *P. muticum* and *P. incanum*. NEW JERSEY. Fort Lee (VII. 1883, *Edwards* ASP). NEW YORK. Ontario Beach (21. VIII. 1892, *N. L. Britton* NYBG). MICHIGAN. St. Joseph (13. VIII. 1917, *Dodge* 548, 599, NYBG); with typical *pilosum;* Caseville (9. IX. 1914, *Dodge* Mich.). PENNSYLVANIA. No further data (*Lesquereux* CAS). TENNESSEE. Cumberland: (9. VIII. 1890, *Coffman* USNH); Mitchellville (VIII. 1897, *Eggert* NYBG); Hollow Rock (5. VIII. 1897, *Eggert* NYBG), with typical *pilosum*. WEST VIRGINIA. Nicholas: Beaver Mills (16. VII. 1890, *Millspaugh* 588, NYBG).

9. Several specimens collected in Missouri are comparable to (8) and suggest a possible combination of *P. pilosum* and *P. albescens:*

Dent: Layton (28. VIII. 1909, *Kellogg* MBG). Newton (15. VII. 1893, *Bush* MBG). McDonald: Anderson (24. VII. 1893, *Bush*).

10. Following are a series of uncertain and intermediate forms which have been collected sporadically throughout the range of the genus in eastern North America. They may represent ephemeral and occasional hybrids, or may represent localized polyploids.

J. D. Smith, July 1882, Maryland. *P. incanum* x *muticum*.

Small 2426, 1895, St. Marys River Swamp, Charlton Co., Georgia. The same?

Britton and Britton, 12. IX. 1885, Doe River Gorge, Pardees Point, Tennessee (ASP, NYBG). Bears capitula suggesting those of *P. clinopodioides* and leaves similar to those of *P. muticum*. May be a mixture of *P. montanum* and *P. muticum*.

Eggleston 5310, 27. IX–9. X. 1909, Kuttawa, Lyon Co., Kentucky (NYBG). Suggests an intermixture of *P. pilosum* and a member of the *P. incanum* group.

Rose and Painter 8113, 5–7. VII. 1904, McCalls Ferry, Pennsylvania (USNH). Similar to *P. virginianum* but the leaves thin and serrate.

Eggleston 5400 (NY), 6. X. 1909, Stiles Station, Kentucky. Has calyces which suggest those of *P. muticum* or *virginianum* but are pilose and the bracts are canescent. Possibly a hybrid of *P. incanum* and *P. virginianum*.

Gattinger, July 1882, Nashville, Tennessee (Stanf.). Bears pubescence and calyces of *P. aristatum* but has slender deflexed leaves suggesting *P. virginianum*. It is far out of range of *P. aristatum* and beyond the range of *P. hyssopifolium*.

Wehmeyer 307, 24. VII. 1924, College Woods, Maryville, Tennessee (Mich.). Suggests *P. clinopodioides* or *P. leptodon* but is hardly typical of either.

West Va. Univ. Biol. Exped., 16. VII. 1931, Beckley Fair Grounds, Raleigh Co., West Virginia (U. W. Va.). Fairly typical of *P. montanum* but with thinly pilose stems and calyces suggesting those of *P. Tullia*.

Chapman, Ocheesee, Florida (GH, ASP, US, NY). Suggests an intermixture of *P. aristatum* or *P. hyssopifolium* and the *P. incanum* group (see previous note on Fernald specimens from Virginia).

Hyams, July 1898, Mica, North Carolina (UC). Suggests a hybrid of *P. muticum;* the calyx teeth are slender and hairy.

Blomquist and Oosting, 31. VII. 1933, Lake Janaluska, Haywood Co., North Carolina (ASP). Resembles *P. incanum* in flowers, pubescence and habit, but has the leaf form of

P. Tullia or *P. Loomisii;* lies far south of the range of *P. incanum;* see note to *Curtiss* 6027.

Hasse, July 1885, Little Rock, Arkansas (NYBG). May be a hybrid of *P. incanum* and *P. muticum.*

Bush, Oct. 21, 1892, Dunklin Co., Missouri. Scarcely to be distinguished from *P. Torrei* save in the smaller capitula.

Small, 26–28, VII. 1895, Brunswick, Glynn Co., Georgia (NYBG, FM). Has the foliage of *P. muticum* but the habit of branching and glomerules suggest a member of the *P. incanum* group, perhaps *P. Loomisii.* Suggests *P. floridanum.*

Curtiss 6027, 16. VII. 1897, pine barrens, Walton Co., Florida (GH). Apparently *P. incanum* but far out of range; see note to collection by *Blomquist and Oosting.*

Palmer 6089, 2. VI. 1914, Corning, Clay Co., Arkansas (UCLA). An anomalous form, perhaps an intermixture of *P. pilosum* and *P. albescens.*

Biltmore Herb., 15. IX. 1899, Cliffs of the Coosa, Rome, Georgia (USNH). Has the habit and pubescence of *P. Loomisii* or *P. Tullia,* but the calyx teeth similar to those of *P. incanum.*

Pollard and Maxon 172, 15–16, VII. 1900, Millersville, Alabama (NYBG). Has the habit and pubescence of *P. Loomisii* but has calyx teeth similar to those of *P. incanum.*

Macoun 1109, 10. VIII. 1871, Lake Region and Ontario, Canada (Kew). Has the habit of *P. incanum,* the pubescence of *P. viridifolium* and the calyces of the latter or of *P. Tullia,* but is far out of the range of either.

Aitchinson, 1884, Carbondale, Illinois (U. Wisc.). Apparently *P. albescens,* but the calyx teeth sharp, though cupped. In this respect it is similar to specimens from western Florida.

Steele 10, 24. VIII. 1903, Seven Mile Mountain, (?) Craig Co., Virginia (USNH). Has the calyx teeth of *P. Tullia,* the habit of pubescence and foliage of *P. incanum.*

Pollard and Maxon 429, 6. VIII. 1900, Lula Lake on Lookout Mountain, Georgia (USNH, NYBG). Calyx teeth variable, some suggesting *P. incanum,* but the habit and pubescence of *P. Loomisii.* On one specimen the calyx teeth are four and subequal.

Svenson 4422, 6. IX. 1930, Morehead, Rowan Co., Kentucky (GH). Apparently a form of *P. Loomisii* with deltoid calyx teeth.

Biltmore Herb. 747a, 10. VII. 1897, Swannoa River, Biltmore, North Carolina (GH, UC, USNH, NYBG). Habit, pubescence and leaves of *P. incanum,* the calyces of *P. Tullia* or *P. Loomisii.*

Hale, Louisiana (Stanf.). Habit, calyx teeth and foliage of *P. albescens* but with a spreading rather coarse pubescence on the stems and lower surfaces of the leaves which suggests the pubescence of *P. viridifolium;* see note to Macoun specimen.

Hale, Louisiana (NYBG). Possibly a hybrid of *P. albescens* and such a form as *P. pilosum.*

Pursh, Cove Mountain, Pennsylvania (ASP). Apparently *P. incanum* but with nearly equal calyx teeth which are gradually tapering.

Beardslee and Kofoid 16, 1. VIII. 1891, Swain Co., North Carolina (USNH). Suggests a mixture of *P. muticum* and some member of the *P. incanum* group.

Bush 6256, 7. IX. 1910, Campbell, Missouri (USNH, MBG, GH) and *E. J. Palmer* 16458 (ASP) 16, IX. 1919, Neelyville, Missouri. Suggest a hybrid of *P. muticum* and *P. albescens.*

Harvey 48, Northwest Arkansas (USNH). May be a hybrid of *P. pilosum* and *P. albescens.*

Bush 6089, 4. VIII. 1910, Montier, Missouri (NYBG). Apparently the same as *Harvey* 48; *Bush* 6088, collected with this, is apparently typical *P. pilosum.*

McClung 6409, 24. VI. 1926, Atlanta, Texas (ASP). Has leaves with the texture of *P. muticum* and calyx teeth suggesting those of *P. Torrei.* May be a hybrid of *P. muticum* and *P. flexuosum.*

Drushel, 9. VIII. 1931, Westfield, New Jersey (MBG). Suggests a possible combination of *P. virginianum* and *P. Torrei.*

E. J. Palmer, 2. VI. 1914, Corning, Arkansas (MBG) and *Eggert,* 8. VIII. 1893, Neelyville, Missouri (MBG) suggest intermediates between *P. albescens* and *P. muticum.*

REFERENCES TO HERBARIA

The following herbarium specimens are representative of the species (indicated by the numbers in parentheses) and are found usually in two or more herbaria:

Abrams 2726 (1); *Allard* 792 (8); 1009 (2); *Andrews* 24. VIII. 1902 (12); *Arsene* 666 (12);

Ball 537 (17); *Bartlett* 745 (2); 1691 (8); *Bartram* 1713 (2); 3034 (16); *Beardslee and Kofoid* 15. VIII. 1891 (11); *Benke* 1454 (13); 4772 (18); 5602 (16); *Benson* 2231 (1); *Bicknell* 23. VII. 1893 (12); 7. VIII. 1897 (12); Biltmore Herbarium 747 (7); 748 (17); 749 (11); 750 (20); 3176 (21); 4441 (16); 6561 (11); 6873 (20); *Bissell* 372 (2); 880 (2); *Blake* 9592 (2); *Blakely* 1464 (17); *Blanchard* 63 (15); 168 (15); *Blankenship* 21. VIII. 1895 (13); *Blewitt* 4394 (12); *Blomquist* 428 (7); *Bolander* 6321 (1); *Bright* 2042 (12); 7336 (16); *Brinkley* 247 (18); *Britton, Britton and Vail* 3. VII. 1892 (19); *Brown* 575 (1); *Burkholder and Muenscher* 16731 (2); *Busch* 146 (3); 184 (3); 209 (3); 212 (13); 260 (13); 300 (17); 301 (16); 440 (17); 449 (17); 450 (13); 470 (17); 472 (18); 478 (17); 1605 (3); 3087 (17); 5024 (3); 5354 (3); 6054 (17); 6088 (13); 6152 (17); 6370 (18); 6408 (3); 7264 (3); 7762 (13); 9452 (13); 10179 (3); 12795 (13); 13128 (13); 15061 (17); 15103 (17);

Camp 1719 (11); *Canby* VIII. 1878 (18); VIII. 1878 (19); *Clark and Seymour* G736 (16); *Copeland* 3837 (1); *Core* 1339 (2); 5576 (2); *Correll* 2388 (20); 3297 (20); 3462 (15); *Curtiss* 1. VIII. 1871 (8); 2002 (17); 2003 (21); 2004 (11); 4391 (21); 5191 (21); 6474 (20); *Cuthbert* 281 (9);

Davis 2108 (6); 2731 (13); 2801 (17); 2816 (17); 3320 (13); 4518 (13); 4663 (13); 6269 (17); 6272 (17); 7845 (8); *Day* 417 (16); *Deam* 9 (16); 191 (16); 1236 (16); 1764 (7); 10105 (7); 14510 (16); 15128 (13) 18676 (7); 19157 (7); 25959 (16); 28189 (13); 38320 (7); 42274 (17); 46423 (17); 51538 (7); 53236 (7); 56601 (16); 58320 (7); 58337 (7); *Demaree* 3728 (18); 8130 (17); 8373 (18); 9372 (17); 9731 (3); 10793 (6); 10815 (15); 10831 (3); 10968 (3); 11500 (16); 13538 (3); 14150 (3); 15472 (3); 15630 (3); 15776 (3); 16350 (3); 18432 (3); *Dixon* 229 (3); 354 (3); 471 (3); 488 (17); *Dowell* 6305 (12); *Dreisbach* 5960 (16);

Earle and Baker 11. VIII. 1897 (6); 17. VIII. 1897 (9); 9. X. 1898 (9); *Eggert* 8–9. VII. 1896 (18); 17. VIII. 1897 (7); 22. VII. 1897 (4); *Eggleston* 1536 (15); 2879 (15); 2892 (16); 4651 (17); 4668 (13); 5090 (21); 5190 (13); 5310 (7); *Erlanson* 1539 (16);

Fassett 2610 (16); *Ferguson* 1673 (16); 3112 (16); 6452 (15); 6801 (15); 7036 (15); 7101 (16); 7715 (2); *Fernald* 393 (18); *Fernald and Long* 4162 (6); 6373 (20); 6374 (20); 6375 (20); 6376 (16); 6378 (18); 6379 (18); 6380 (19); 6381 (6); 7594 (6); *Fernald* et al. 262 (17); 5020 (20); 5022 (8); 5026 (6); 5027 (6); 6380 (19); 6677 (6); 6678 (8); 6679 (19); 10312 (16); 10313 (2); *Fisher* 130 (17); 5085 (3); *Fogg* 4501 (19); 7112 (2); *Friesner* 6398 (13); 9751 (13);

Gates 201 (16); 586 (16); 2874 (16); *Gattinger* 1994 (2); *Geyer* VII. 1842 (13); *Goessl* 9023 (16); *Grant* 826 (1); *Graves* 1823 (13); *Gray and Carey* VII. 1841 (11); *Greene* 1026 (1); *Greenman* 473 (15); 1552 (18); 1909 (16); 3762 (17); 3792 (17);

Hall 440 (3); *Hansen* 696 (1); *Harper* 103 (17); 173 (4); 586 (9); 680 (2); 837 (20); 3239 (17); *Harvey* 64 (13); *Heller* 141 (11); 649 (17); 650 (2); 22. VII. 1890 (11); 28. VII. 1893 (8); 24. VII. 1901 (12); 27. IX. 1901 (2); 1011 (20); 1157 (8); 1157 (9); 1196 (17); 4093 (3); 12552 (1); 13493 (1); 14013 (2); *Heller and Holbach* 651 (18); 1196 (16); 1368 (2); *Hermann* 6424 (16); *Hitchcock* 794 (16); 795 (17); 796 (13); 1505 (20); 1507 (5); 1508 (5); *Hood* 17. VII. 1910 (5); *Houghton* 3829 (17); 4010 (17); *House* 2687 (20); 3017 (9); 4384 (6); 4401 (17); 10648 (2); *Hunnewell* 6717 (2); 9265 (11); 10678 (2); 12222 (2);

Jennison 6. VII. 1929 (7); *M. E. Jones* 3459 (1);

Kaufman 225 (16); *Kearney* 866 (11); 867 (17); 2225 (18); *Kellogg* 15288 (13);

Lansing 2807 (16); *Le Buhn* 522 (16); *Lighthipe* 528 (21); *Long* 590 (19); 5053 (19);

MacDaniels 4910*a* (2); *MacElwee* 1158 (2); *Mackenzie* 267 (2); 394 (3); 533 (3); 957 (6); 2227 (18); 2818 (18); 4314 (16); 4751 (2); 4815 (19); 4937 (2); 6209 (15); 7293 (16); *Marie-Victorin* 25668 (16); *Mathews* 2478 (16); *McFarland* 175 (6); *Mearns* 119 (2); 120 (2); *Metcalfe* 7088 (16); *Miller* 1598 (2); 1600 (2); 1606 (15); *Millspaugh* 249 (17); *Moldenke* 54 (16); 1320 (17); 6064 (16); 8137 (16); *Morris* 1037 (8);

Nash 2182 (2); 2226 (21); 2259 (5); 2316 (21); 2514 (20); *L. W. Nuttall* 1339 (9);

Oosting 35369 (11); *O'Neill* 6. VI. 1927 (18);

Painter 783 (17); *E. J. Palmer* 293 (1); 495 (17); 3809 (13); 3828 (3); 4171 (3); 4347 (13); 4546 (3); 6755 (3); 8125 (18); 8603 (3); 8828 (3); 9003 (3); 10477 (3); 14435 (3); 16547 (6); 17055 (6); 17055 (7); 20211 (3); 20232 (3); 23975 (3); 29427 (3); 29467 (3); 31597 (13); *Pammel* 728 (13); *Pammel and Ball* 91 (16); *Parish* 608 (1); *Peattie* 708 (11); *Pennell* 2448 (2); 4236 (3); 6674 (16); 7725 (2); 8704 (16); 9485 (16); 11093 (2); 12866 (19); *Phelps* 829 (16); 831 (15); 1197 (17); *Pollard* 514 (2); 1115 (3); 1247*a* (3); *Pollard and Maxon* 172 (4); 467 (4); 555 (21); *Randolph* 690 (20); 1158 (15); *Ravanel* VIII. 1869 (9); *Redfield* 6486 (20); 11498 (2); *Reverchon* 2122 (3); *Riehl* 154 (13); *Rugel* 241 (21); 244 (5); VII. 1841 (11); VII. 1843 (20); *Rusby* 2000 (18); *Ruth* 503 (7); 509 (6); 526 (6); 3306 (16); *Rydberg* 8188 (8); 8205 (8); 9452 (11); 9503 (8);

Safford 376 (15); *Seymour* 239 (18); 588 (16); 697 (2); 1330 (17); *Sherff* 637 (18); *Shreve and Jones* 1157 (19); *Shull* 162 (18); *Small* 11550 (5); 24. VII. 1889 (18); 7. VIII. 1889 (12); 2. VIII. 1890 (18); 9. IX. 1890 (12); 26. IX. 1891 (18); IX. 1892 (12); 12. VII. 1892 (15); 12. VII. 1892 (18); 12. VII. 1892 (8); 16. VII. 1892 (6); 16. VII. 1892 (8); 27. VII. 1892 (6); 27. VII. 1892 (15); 2. VIII. 1892 (8); 5. VIII. 1892 (18); 6. VIII. 1892 (8); 27. VII. 1893 (4); 8. VIII. 1893 (7); 1–3. IX. 1894 (9); 6–12. IX. 1894 (4); 28. V, 6. VI. 1895 (20); 26. VI. 1895 (19); 24–26. VII. 1895 (21); *Small and Heller* 336 (8); 13–18. VIII. 1891 (6); *Small and Huger* 3. X. 1901 (12); *Small* et al. 11019 (3); 11454 (20); *H. H. Smith* 1557 (18); 2221 (20); 2367 (4); 2416 (7); 2482 (11); 2494 (11); 7875 (16); *Smith and Hodgdon* 3982 (2); 4047 (13); 4201 (13); *Standley* 5328 (2); 5385 (6); 8394 (13); *Standley and Bollman* 9990 (11); 10093 (8); 11870 (16); *Steele* 16 (15); 58 (11); 18. VII. 1896 (12); *Steele and Steele* 10 (8); 16 (15); *Stevens* 2020 (17); 2205 (17); 2680 (3); 3422 (3); 4133 (13); *Steyermark* 2027 (3); 6787 (13); 7196 (13); 11406 (17); 11750 (3); 11806 (16); 13270 (13); 13378 (17); 13973 (3); 14172 (3); 14311 (3); 14380 (13); 15598 (3); 23173 (3); 23559 (3); 23881 (13); 25491 (13); *Svenson* 116 (4); 6914 (20);

Taylor 2260 (15); *Tharp* 2536 (17); *Tidestrom* 6887 (6); *Townsend* 27. VII. 1897 (9); *Tracy* 4902 (3); 8758 (3); *Trelease* 537 (17); 731 (17); 732 (17);

Uhler 308 (16); *Umbach* 1156 (16); 4476 (16); 4746 (16);

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Wehmeyer 730 (7); *Wherry and Pennell* 13860 (6); *Wiegand* 3091 (2); *Wiegand and Manning* 2753 (20); 2754 (19); 2755 (20); 2760 (20); 2767 (21); 2769 (8); 2770 (6); 2771 (8); 2772 (9).

REJECTED OR DUBIOUS NAMES

K. virginiana Kuntze, Rev. Gen. 520, 1891.

K. virginica Baill., Hist. des. pl. 10:31, 1892.

K. lanceolata Kuntze, l. c.

P. alatum Raf., Fl. Ludov. 40, 1817 = ?

P. decurrens Blanco, Fl. Filip. Ed. 2: 333, 1845 = *Hyptis rhomboidea* M. and G., (*H. decurrens* Epl.).

P. Monardella Michx., Fl. Bor. Amer. 2: 8, pl. 34, 1803 = *Monarda fistulosa.*

P. rosmarinoides Raf., loc. cit. = ?

P. subulatum Blanco, l. c., 333 = *H. brevipes* Poit.

Origanum clinopodioides Walt., Fl. Carolin., 165 = *P. aristatum* Michx. fide A. Gray.

O. incanum Walt., Fl. Carolin., 165
= *P. aristatum* Michx. fide A. Gray.

O. punctatum Poir., Encycl. Suppl. 4, 186.
= *P. incanum* Michx. fide A. Gray.

Thymus lanceolatus Poir., Encycl. Suppl. 5: 305, 1804. = ?

T. serratus Poir., Encyl. 7: 653, 1806. = ?

T. verticillatus Poir., loc. cit. = ?

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THE GENUS CLARKIA

BY

HARLAN LEWIS AND MARGARET ENSIGN LEWIS

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THE GENUS CLARKIA

BY

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INTRODUCTION

A TAXONOMIC TREATMENT of the genus *Clarkia* (Onagraceae) has become desirable in view of recent evidence derived primarily from cytological and genetical studies (see papers by Håkansson, Hiorth, and Lewis). This evidence requires a reexamination of generic limits and a reevaluation of species previously delimited primarily from herbarium studies. Our investigation of this genus is not yet complete and subsequent evidence will probably alter some of the suggestions presented here. However, the main outline of specific delimitation and relationships seems assured.

The most important criterion used to delimit the various taxa and to determine their relationships has been morphology, despite the fact that taxonomic treatments of this group based solely upon morphological studies have proved inadequate. Our morphological studies are based on herbarium material, field observations, and on cultivated progenies from wild seeds. They have been supplemented and, in many instances, clarified by chromosome studies of the various taxa, including the meiotic behavior of hybrid combinations. Extensive hybridization has supplied information concerning genetic relationships and especially the extent and nature of barriers to gene exchange. In addition, studies of the breeding habit, geographical distribution, and ecology have contributed materially to an understanding of relationships.

ACKNOWLEDGMENTS

We are indebted to innumerable individuals who have contributed to our work on this genus, particularly to the curators of the many herbaria who have sent material on loan and who have provided us with facilities for study at their institutions. In addition, many individuals have very kindly contributed seeds or other material, namely, Howard Brown, Henry Bruman, Lincoln Constance, Carl Epling, Ruth Epling, Wallace R. Ernst, Percy Everett, Verne Grant, Robert Hoover, Eugene Kozloff, Arthur Kruckeberg, R. Paul Levine, Mildred Mathias, John Mooring, Marion Ownbey, C. R. Quick, G. Thomas Robbins, John Roberts, Margaret Roberts, Richard Snow, G. Ledyard Stebbins, Jr., and Frank C. Vasek. We are also grateful to Carl Epling, Mildred Mathias, and Henry J. Thompson for comments and suggestions concerning the manuscript.

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DISTRIBUTION AND COLONIAL HABIT

Clarkia is a genus of annuals endemic to western temperate North America except for a polyploid complex, *C. tenella*, in South America. All of the species occur in more or less discrete colonies of varying size. In general, the colonies consist of several hundred or several thousand individuals, and some colonies may carpet extensive areas visible for several miles. On the other hand, one may occasionally find a solitary plant. The distributions have not been altered greatly by man, except perhaps locally. Several species, however, may once have been more abundant in the valleys which are now extensively cultivated, particularly the Central Valley of California.

The North American species are associated primarily with well-drained soils in open sites in oak woodland, but many species occur in adjacent, usually more xeric communities. The available data suggest that the genus originally occupied an ecotone between the Arcto-Tertiary and Madro-Tertiary Floras and that more recent species have been adapted to the more xeric derivatives of the Madro-Tertiary Flora (Lewis, 1953*b*).

MORPHOLOGICAL STUDIES

HERBARIUM MATERIAL

Collections of the genus available at the following institutions and herbaria were kindly loaned to us: California Academy of Sciences, Dudley Herbarium of Stanford University, Pomona College, University of California (Berkeley), Washington State College, Rocky Mountain Herbarium of the University of Wyoming, Philadelphia Academy of Sciences, Missouri Botanical Garden, United States National Herbarium, New York Botanical Garden, University of Arizona, Gray Herbarium of Harvard University, and San Diego Museum of Natural History. Particular sheets have also been kindly loaned to us from the Nevada Experiment Station (Reno), the Jepson Herbarium (University of California), and the Natural History Museum, Paris. In addition, we have been able to study the type specimens and other collections in the Jepson Herbarium, Rancho Santa Ana Botanic Garden, the Greene Herbarium (Notre Dame), and the Herbarium of the University of Idaho, as well as the following European herbaria: Kew, Cambridge (including the Lindley Herbarium), Paris, Brussels, and Utrecht. We were fortunate in having available for simultaneous study more than ten thousand herbarium sheets, in addition to our own collections which total nearly a thousand accessions and include all of the North American species.

TYPE SPECIMENS

We have examined type specimens of all described species and lesser categories except when indicated otherwise following the description of the taxon. Synonyms based upon the same type are listed in the same paragraph. No type specimen can be found for some of the earliest described species, but the original description was often accompanied by an excellent colored plate which is taken as the type. Where a type specimen and illustration both exist, the illustration is frequently more definitive.

FIELD STUDIES

We have been able to study all of the North American species in their native habitats. An incalculable number of colonies have been observed, and approximately a thousand have been carefully studied and collections made from them. A few taxa have been found only once, but the large majority of the species have been examined in numerous colonies throughout most of their areas of distribution. All of the known colonies of two restricted species have been examined. Our field notes include observations of habitat as well as information concerning colors, color patterns, and other features which disappear or change appreciably in dried specimens. Representative samples of twenty-five to fifty individuals were usually preserved as pressed specimens for further morphological studies. In some instances, samples of flowers were preserved in alcohol. Samples of buds for meiotic studies and seeds were also taken whenever they were available. From meiosis to the production of mature seeds requires at least two months. Only on rare occasions, therefore, can one obtain buds, flowers, and seeds at the same time. Our practice, consequently, was to make two trips to a locality, the first to locate the populations and to obtain samples of buds and flowering individuals, the second to obtain seeds. One can usually obtain abundant seeds for a number of weeks after the flowering period has passed, because the seeds are not rapidly shed. We have also found that immature capsules can be matured by keeping the stems in water. Seeds matured in this way are sometimes shriveled and apparently do not have the vitality that characterizes normally ripened seeds, but we have encountered very little difficulty in germinating them within the first year or two. The degree of shriveling is determined by the time of picking.

GARDEN STUDIES

Progenies of all of the known species have been grown under cultivation, mostly from wild seeds. The material of the South American species has been from cultivated strains only. In all, over three hundred different wild colonies were represented. Some were planted in rows in the garden, others were grown in a uniform soil mixture in the greenhouse or under screen or lath. At Los Angeles, the seeds are usually planted about the first of November and, depending upon the species, begin to flower out-of-doors in April or May. Seeds planted in January or February produce plants that are somewhat smaller and bloom a little later. The flowering season usually lasts through June in both instances. Progenies grown in England in 1947 were planted in the spring and flowered throughout the summer. The time of flowering can be readily altered by changing the environment. Progenies grown under controlled conditions at the California Institute of Technology indicate that flowering is promoted by long periods of light and relatively high temperatures (Lewis and Went, 1945). But the temperatures which promote rapid flowering also prevent all or many of the seeds from germinating. In other words, germinating seeds and young seedlings have different requirements from plants which are vegetatively mature. With the proper sequence of environments one can force some species to complete a cycle from seed planting to seed harvest in four months. Plants grown under these conditions are, however, relatively small and weak, and they produce few flowers.

Cultivation has permitted comparison of the morphology of the same and of different species under uniform cultural conditions where environmental modification can be treated as a constant. Morphological characteristics which become altered or obscured in dried specimens but which are incorporated in our descriptions and keys were carefully checked by using these representative progenies grown simultaneously. These progenies have also served as the parental plants for our hybridization program.

MORPHOLOGICAL CHARACTERS

Morphological characters used to delimit and typify various taxa are discussed below. Many of the characters which permit the immediate recognition of the living plants of some taxa completely disappear or become altered or obscured in the preparation of herbarium specimens. It is accordingly difficult to assign many herbarium sheets to their proper taxa with any degree of certainty. For this reason, an adequate taxonomic treatment of this genus is virtually impossible from a study of herbarium material alone.

All of the descriptions and keys which follow have been checked for accuracy against living material, but it must be borne in mind that these diagnostic characters may not be evident on some herbarium sheets. For example, a petal described as having a bright-red spot may be found on many herbarium sheets to have no spot at all or the spot may be a dull purple. But color is not the only character which may become obscure or altered. The grooving or ribbing of the enlarged ovary before it has become a dry capsule is a constant and useful diagnostic character of living plants. But a 4-grooved ovary may become wrinkled after desiccation and thus appear as an 8-ribbed ovary to one unfamiliar with the genus. Or it frequently happens that the ovary is pressed tissue-paper thin and has thus lost all of its character, including its original shape. One of the most useful characters of living material is the orientation of the rachis of the inflorescence which may be straight above the open flowers or may be bent conspicuously downward so that the upper buds are pendulous. For example, this is the only reliably constant character, short of counting chromosomes, that will distinguish *C. amoena huntiana* from *C. gracilis sonomensis*. Yet, when a bent inflorescence is found on a herbarium sheet it may be that the plant was pressed after it had wilted or that the tip was bent deliberately to fit the plant to the press. At the same time, we have watched collectors carefully straighten the tips of plants which were naturally recurved.

After working with a group of plants for some time, one can usually circumvent such difficulties, as we have indicated, and identify a particular herbarium specimen by an intuitive summation of subtle characters. But this is of no help to one who does not have access to the services of such a specialist. We have therefore tried to describe the various taxa as far as possible by characteristics which are evident in ordinary herbarium preparations but have also included characteristics in the keys and descriptions which will facilitate recognition of living plants. Characters which are most likely to change upon pressing are indicated below. We urge collectors to make note of them when the plants are fresh. This information, along with other pertinent data, should be included on the herbarium sheet.

Stems.—The branching habit of many races and species is a useful characteristic when the taxa considered are grown under uncrowded, uniform cultural conditions. The same is true of stem height and diameter. We have not, however, emphasized these differences in our descriptions and keys inasmuch as they are most readily affected by the environment. For example, the great majority of collections made in the wild do not show characteristic branching patterns because frequently they have very few, if any, branches. Coastal populations of several species are prostrate or procumbent, and this character is diagnostic for two species (*C. prostrata* and *C. davyi*). Yet, when plants are reduced to two dimensions on a herbarium sheet, a prostrate habit is usually not evident and should be noted by the collector. Stem pubescence is of little diagnostic value in most instances, because it is similar in most species. Glaucous stems are characteristic of certain sections and should be noted by the collector, for it is usually difficult to determine from herbarium material whether or not a stem was glaucous. Internode lengths as related to the length of other organs have been used in several instances, since they can be readily ascertained from herbarium material. These relationships, however, should be evaluated with caution, because they are subject to considerable variation.

Leaves.—Leaf shape and size are useful characters when the differences are sufficiently great to be beyond the ordinary range of environmental modification. The presence or absence of a petiole may also be a useful diagnostic character. The margin of the leaf may be entire or denticulate but may vary on a single plant, although the leaves of some species are characteristically entire and others are usually denticulate. The leaves are crowded in some taxa and remote in others. Differences in leaf texture may be conspicuous in living plants but disappear completely upon desiccation.

Rachis of the inflorescence.—The stems of all species are initially straight, but conspicuous differences develop as flower buds are formed. In many species the stems continue straight, in others they become deflexed, and in still others they become abruptly recurved so as to appear wilted. In most species in which the rachis is recurved, it straightens a short distance above the uppermost open flower, but it straightens well in advance of the uppermost open flower in one species (*C. virgata*). We have found this curvature of the rachis to be one of the most constant traits of some taxa and consequently one of the most reliable in differentiating them. It is easily distorted, however, in preparing herbarium specimens. When the last flowers have opened, it is no longer possible, of course, to tell whether or not the rachis was recurved.

Buds.—Species with recurved stem tips have pendulous buds. Species with the tips of the inflorescence curved to one side have deflexed buds, but those with straight stems may have the buds either deflexed or erect.

Flowers.—Species and races frequently show characteristic differences in flower size, and these in turn are generally correlated with breeding habit. Small-flowered taxa are as a rule self-pollinated. The style is equal to the stamens in length, and the anthers and stigma not only mature at the same time but actually adhere to one another so that the pollen is deposited directly upon the stigma. In the larger-flowered taxa the stigma is generally held well above the anthers, and the flowers are protandrous. Flower size may be greatly modified by the environment, and a tenfold reduction in the size of the larger-flowered forms is not uncommon (Lewis, 1953*a*). These environmentally induced small flowers, however, do not show a corresponding modification of the relative lengths of the stamens and style nor in the time of anther and stigma maturation.

Sepals.—The sepals at anthesis may be reflexed individually, or they may remain united at the tips in pairs, or all four may remain together and are then merely deflected to one side rather than being reflexed. On the whole, the behavior of the sepals is a useful diagnostic character which can be determined readily from herbarium sheets, but some variation does occur in certain species. Before the buds open, the tips of the sepals in some species are free for as much as a millimeter. These free tips are readily observed in pressed buds of species in which they occur inasmuch as pressing usually causes them to spread apart.

Hypanthium.—The hypanthium may be very long and slender, but more frequently it is funnelform, obconical, or cup-shaped and may be quite short and relatively inconspicuous. These differences in size and shape are frequently diagnostic.

One conspicuous feature is a ring or band of hairs on the inside which closes the hypanthium at that point. This ring is located a few millimeters above the base and may function to keep the nectaries at the base of the hypanthium from becoming desiccated. Species with a relatively long hypanthium have the ring of hairs close to the base; those with short hypanthiums often have it at the upper margin. It is absent in species with a very long, slender, or very small hypanthium, in which case the filaments and style completely fill the orifice. The hypanthium is sometimes conspicuously colored within, particularly in species in which it extends above the ring of hairs. This ring is replaced in Section Clarkia and Section Myxocarpa by conspicuous hairy scales at the base of the stamens.

Petals.—Petal conformation, particularly the presence or absence of conspicuous claws or lobes, is an excellent character for distinguishing many species and can be readily ascertained from herbarium sheets. Petal size is useful within broad limits, but the extent to which it can be modified by the environment is extensive (Lewis, 1953*a*). The color and color pattern of the petals are extremely useful characters in living material. Unfortunately, they are usually altered or obliterated in dried specimens and should certainly be noted while the plants are still fresh. The shape, position, and color of a petal spot are also important diagnostic characters, as well as the presence or absence of flecks or zones of color.

Stamens.—The stamens are characteristically in two series of four each, the inner series being opposite the petals and shorter than the outer. The inner series is abortive and nonfunctional in Section Clarkia and completely absent in Section Eucharidium.

Anthers.—The anthers are usually blunt at the apex, but two sections are characterized by anthers with acute or mucronate sterile tips. These differences in anther shape are readily perceived only in fresh material before the anthers have completely dehisced. The anthers in the two series of stamens within a flower may be similar or they may differ conspicuously in size and color. The color usually fades completely or is greatly altered in pressed specimens. The anthers of *Clarkia* are unusual in that the sporogenous cells in each anther are separated by vegetative cells into a series of vertically arranged packets.

Pollen.—The pollen is normally 3-cornered in the naturally occurring diploid and tetraploid species but is frequently 4-, 5-, or 6-cornered in some populations of the hexaploid species. Artificially induced polyploids also have pollen grains with more than 3 lobes. The development of the pollen grain of *C. unguiculata* has been described in detail by Geitler (1937). The color of the fresh pollen may be white, yellow, blue, gray, lavender, or pink, but the color may not be evident after drying. Particular colors and color combinations are characteristic of certain species or groups of species.

Stigma.—The shape and color of the stigma are frequently useful characters. The position of the stigma with respect to the stamens, which is a function of the length of the style, is associated with the mode of pollination and is also frequently diagnostic.

Ovary.—The distinctive characteristics of the ovary are most conspicuous after it has reached its full size following fertilization. It may be deeply and conspicuously 8-ribbed, or 4- or 8-grooved, or merely striate. But these characteristics are for the most part lost when the ovary dries to form a mature capsule or when it is dried in pressing. The capsules illustrated in the figures of the text represent mature ovaries just before they become dry. In drying to form a capsule, the ovary decreases appreciably in diameter, particularly in the strongly 8-ribbed species. The outer tissues, except for the epidermis, break down and become slimy or mucilaginous in Section Myxocarpa. The pubescence of the ovary is sometimes useful as a character, but the kinds and abundance of hairs often vary conspicuously within a single species.

Seeds.—Mature seeds are brown or gray and are covered with tubercles or scales formed by enlarged protruding epidermal cells. Still larger cells form a crest at the upper margin. The seeds may differ in shape, size, and in the expression of the crest.

CHROMOSOME STUDIES

Chromosome numbers have been determined for each species from root-tip sections or squash preparations of microsporocytes and root tips (for technique see Appendix I). Genomes of 5, 6, 7, 8, 9, 12, 14, 17, 18, and 26 chromosomes have been found (table 1). The original basic number was almost certainly 7 (Lewis, 1953*b*). Genomes of 6 are known only in natural populations of *C. amoena* which has a basic number of 7 (Håkansson, 1945*b*, 1946*a*). A basic number of 5 is found only in *C. virgata.* These genomes with fewer than 7 chromosomes have apparently arisen as a result of translocation and subsequent loss of centromeres. Basic numbers of 8 and 9 apparently differ from 7 by the equivalent of whole chromosomes (Lewis, 1954). These additional chromosomes may have been derived in the same manner as the supernumerary chromosomes which are found in wild populations of at least five species (table 1). Genomes of 12 or more chromosomes are from polyploid species (fig. 1).

Differences in chromosome number at the diploid level between species of *Clarkia* are correlated with ecological adaptation. The species with genomes of 8 and 5 chromosomes occupy drier habitats than their relatives with 7, and those with genomes of 9 occupy the most xeric areas in which the genus occurs (Lewis, 1953*b*).

Species of *Clarkia* have characteristic differences in chromosome size and conformation which are useful as indicators of relationship. These differences must be evaluated with caution, however, inasmuch as methods of fixation and preparation may alter the size. Differences in relative chromosome size can, nevertheless, be compared reliably in certain interspecific hybrids in which the difference in size of the parental chromosomes is maintained. For example, the relatively large chromosomes of *C. deflexa* maintain their proportional size in hybrids with *C. tenella* (Chittenden, 1928), *C. bottae* (Håkansson, 1943*b*), *C. cylindrica*, and *C. biloba.*

Structural rearrangement of the chromosomes has played an important part in species differentiation. This is evident from the ring, chain, and bridge-fragment configurations found at meiosis in the interspecific hybrids studied by Håkansson (1941*b*, 1942, 1943*a*, *b*) and by us. At the same time, other rearrangements are undoubtedly concealed by the failure of many chromosomes in these hybrids to pair and form chiasmata. Structural rearrangement, however, is probably the major cause of this lack of pairing, as is indicated by the numerous successful alloploid species which have been produced from such hybrids. Individuals heterozygous for structural rearrangements are frequent in wild populations of some species of *Clarkia* (table 1). The differential accumulation of such rearrangements in different populations may produce barriers to gene exchange which lead to species formation. At the same time, these rearrangements may also set the stage for change in basic chromosome number which has frequently accompanied speciation in this genus (Lewis, 1953*a*, *b*, 1954).

TABLE 1

CHROMOSOME NUMBERS AND CHROMOSOMAL IRREGULARITIES IN SPECIES OF *Clarkia**

Species	n	T	S	Remarks
affinis	26			
amoena subsp.				
amoena	7	6r		
caurina	7	4r		T found only in interpopulational hybrids.
huntiana	7	12r		Genomes of 6 found as heterozygotes in 5 populations.
lindleyi	7	two 4r		
whitneyi	7	6r		
arcuata	7			
biloba	8	4r		T found only in interpopulational hybrids.
bottae	9	4r		
breweri	7			
concinna	7			
cylindrica	9			
davyi	17			
deflexa	9			
delicata	18			
dudleyana	9			
epilobioides	9			
exilis	9			
gracilis subsp.				
albicaulis	14		1	
gracilis	14			
sonomensis	14		4	
imbricata	8			
lassenensis	7		f	
lingulata	9			
mildrediae	7	6r		T only in interpopulational hybrids.
modesta	8		?	See under *modesta* in text.
nitens	9			
prostrata	26			
pulchella	12			
purpurea	26	4r	1	T and S observed only in interpopulational hybrids. See text for other counts.
rhomboidea	12	5c + 1	1	S in only one plant. T only in interpopulational hybrids.
rubicunda	7			
similis	17			
speciosa	9	3c + 1	?	See under *speciosa speciosa* in text.
tenella	17			
unguiculata	9	8r	6	
virgata	5		3	S in only one plant.
williamsonii	9		3 + f	
xantiana	9			

*References and further details are found in the discussion following each species description.
n = normal gametic number. T = Translocation heterozygotes. The figure given is the maximum association observed, r = ring, c = chain. S = supernumerary chromosomes comparable in appearance to normal chromosomes. The number shown represents the maximum observed in any one individual. f = small fragment chromosomes in addition to the normal complement.

INTERSPECIFIC HYBRIDIZATION

NATURAL HYBRIDS

Nearly every species of *Clarkia* is sympatric with at least one other species over part of its area of distribution, and three or more species are frequently found growing together (table 2). Nevertheless, no naturally occurring interspecific diploid hybrids have been found. However, the prevalence of alloploid species, which are derived from interspecific hybridization, indicates that such hybridization does occur, but apparently at a low frequency. Several reasons may account for this low frequency of naturally occurring interspecific hybrids, including selective pollination, self-pollination, genic barriers, and the adaptedness of the hybrids.

All of the species are visited by various kinds of bees, which are undoubtedly the principal pollinators of the genus. Some species of bees may be highly selective in their visits which will result in a very low frequency of interspecific hybridization (Mather, 1947; Grant, 1950). We have observed selective pollination of *Clarkia* by domestic honey bees in our garden planting at the John Innes Horticultural Institution in England. About fifty progenies representing some twenty species were grown in rows in the garden. The sequence of the progenies was based upon accession number rather than relationship. Consequently, progenies of the same species were distributed more or less at random. All of the progenies were worked extensively by bees, but repeated observation indicated that individual bees confined themselves to only one progeny on a particular collecting trip or that they visited only other progenies of the same species, although often investigating but not stopping at progenies of closely related, and morphologically similar, species. Exceptions to this behavior were extremely few. Open pollinated seeds from progenies in this garden were subsequently sown at Los Angeles, but not one interspecific hybrid was obtained.

Self-pollination may greatly restrict interspecific hybridization between some species of *Clarkia*. The flowers of most of the species are protandrous, and the mature stigma is held above the stamens. Outcrossing is certainly promoted in these species even though all of the species are self-compatible. But some races and species have cleistogamous flowers and are primarily or almost exclusively self-pollinated. Various intermediate degrees of self-pollination also occur (Lewis, 1953*a*). Even though self-pollination does undoubtedly greatly restrict the opportunities for interspecific hybridization between some species, such hybridization obviously does occur at least on rare occasions inasmuch as some of the alloploid species have been derived from normally self-pollinating species.

Genic barriers to interspecific hybridization and the relative adaptedness of interspecific hybrids as compared to their parents are evident from artificial crosses made under cultivation in uniform cultural conditions.

GARDEN HYBRIDS

We have made several thousand interspecific pollinations involving at least 202 species combinations. Of these, fifty-five combinations have produced viable hybrids. The results are summarized in table 3. Additional crosses have been made by Rasmuson (1921), Hiorth (1941), and Chittenden (1928). The vast majority of interspecific pollinations have produced no seeds. The reasons for this failure are several. Sometimes the pollen does not germinate or scarcely penetrates the style. But in

TABLE 2—Species Found Growing in Mixed Colonies

	amoena	rubicunda	arcuata	lassenensis	gracilis	imbricata	williamsonii	nitens	speciosa	tenella	davyi	prostrata	purpurea	affinis	bottae	cylindrica	biloba	lingulata	modesta	dudleyana	epilobioides	similis	deflexa	delicata	unguiculata	exilis	xantiana	mildrediae	virgata	rhomboidea	pulchella	concinna
amoena					×								×																	×		×
rubicunda											×		×																			
arcuata					×		×						×																	×		
lassenensis					×								×																	×		
gracilis	×		×	×									×				×								×					×		
imbricata																																
williamsonii			×					×					×			×	×		×	×					×							
nitens							×						×			×			×													
speciosa													×			×							×		×							
tenella																																
davyi		×											×																			
prostrata																																
purpurea	×	×	×	×	×		×	×	×		×			×	×	×	×		×	×	×	×	×	×	×					×		
affinis													×						×						×							
bottae													×												×							
cylindrica							×	×	×				×						×	×			×		×	×	×					
biloba					×		×						×							×					×					×		
lingulata																				×												
modesta							×	×					×	×		×				×	×				×							
dudleyana							×						×			×	×	×	×						×					×		
epilobioides													×						×			×		×	×							
similis													×								×			×								
deflexa									×				×			×									×							
delicata													×								×	×										
unguiculata					×		×		×				×	×	×	×	×		×	×	×		×			×	×	×		×		
exilis																×									×		×					
xantiana																×									×	×						
mildrediae																									×					×		
virgata																														×		
rhomboidea	×		×	×	×								×				×			×					×			×	×			
pulchella																																
concinna	×																															
breweri																			×						×							

most cases, styles examined 4 hours after pollination showed that the pollen had germinated and that the pollen tubes were growing normally. Even then, fertilization apparently does not take place in many crosses. Lack of fertilization can be inferred from the following behavior. Fertilization normally occurs about 38 to 40 hours after effective pollination (Johansen, 1927), whereupon the petals wither within a few hours and the flowers abscise at the top of the ovary. Unpollinated flowers remain fresh for a week or two and eventually abscise more or less simultaneously at the base as well as the tip of the ovary. The same is true of the interspecific pollinations indicated above, in which fertilization apparently does not occur. Abscission, however, at the top of the ovary occurs rapidly in some interspecific pollinations, indicating that fertilization has probably occurred. Even then, no seeds may be formed; in other instances only shrunken seeds are produced. Occasionally a seedling is obtained from one of these shrunken seeds. When plump seeds are produced they seldom fail to germinate. In many instances only an occasional good seed is produced, but in some instances interspecific hybrids are readily obtained. The results of interspecific pollination may vary as a result of both environmental and genotypic factors. Repeated crosses involving the same individuals may fail, only to be followed for unknown reasons by success. Failure to obtain a particular interspecific hybrid can sometimes be overcome by using individuals from other colonies of the same species.

We have also found that results from controlled pollinations in the experimental garden are not necessarily those which obtain in the wild. For example, our attempts to produce hybrids with *C. xantiana* as one parent have consistently failed, although we have found spontaneous interspecific hybrids involving this species in a population which we established artificially in a canyon in Kern County.

Interspecific hybrids that we have obtained are often vigorous and may be more robust than the parental stock. On the other hand, interspecific hybrids may be weak or abnormal. For example, the only hybrid we have been able to obtain between *C. biloba* and *C. dudleyana* was vegetatively vigorous but did not produce any flower buds under the conditions in which both of the parents flowered abundantly. Other hybrids are dwarfs, and these frequently do not flower or produce highly abnormal flowers which cannot be used for meiotic studies of relationship. The hybrids between *C. amoena* and *C. arcuata* obtained by Hiorth (Håkansson, 1946*b*) were dwarfs of this kind. Furthermore, a hybrid progeny from the same capsule may vary greatly; for example, seeds from a single capsule resulting from a cross between *C. lassenensis* and *C. amoena* produced sixteen seedlings. Most of these did not grow beyond an expansion of the cotyledons and showed no evidence of an epicotyl. Others had highly abnormal and fused cotyledons, which formed an irregular growth at the top of the hypocotyl. Some plants, on the other hand, produced leaves but were abnormal and dwarfed, although one plant grew vigorously and more or less normally.

All of the interspecific hybrids that have been produced show a great reduction in fertility when self-pollinated, when backcrossed to either parent, or when open-pollinated in the garden in the presence of one or both of the parental species. Most of our hybrids have produced none or very few seeds under these conditions, whereas the most fertile hybrid (*C. biloba brandegeae* × *C. lingulata*) set a maximum of about a third of the normal seed set when backcrossed to either parent. The basis of the high degree of sterility in interspecific hybrids of *Clarkia* lies primarily in the struc-

TABLE 3—Results of Interspecific Pollinations

	amoena	rubicunda	arcuata	lassenensis	gracilis	imbricata	williamsonii	nitens	speciosa	tenella	davyi	prostrata	purpurea	affinis	bottae	cylindrica	biloba	lingulata	modesta	dudleyana	epilobioides	similis	deflexa	delicata	unguiculata	exilis	xantiana	mildrediae	virgata	rhomboidea	pulchella	concinna	breweri
amoena		X	X	X	X		—		—	—*		—	—		—	X	—	—	—	—			X		—		—			—	—*	—	
rubicunda	X		X	—	X		—		—	—*		—	—			X	—	—	—	—			—		—		—		—			—	
arcuata	X	X		—	X		—		—				—		—	—	—	—	—	—			—		—		—						
lassenensis	X	—	—		X		—		—			—	—			—	—	—	—	—		—	—		—		—						
gracilis	X	X	X	X			—		—							—	—	—	—	—			X*		—		—					—	
imbricata							X	X	X																								
williamsonii	—	—	—	—	—	X		X	X		X	X	X	X	—	—	—	—	—	—			—		—		—			—		—	
nitens						X	X		X																								
speciosa	—	—	—	—	—	X	X	X			X	X	X	—	—	X	—	—	—				—		—		—		—	—		—	
tenella	—*	—*											—*										X*										
davyi							X		X				X												—								
prostrata	—	—		—			X		X				X				—						—		—								
purpurea	—	—	—	—			X		X	—*	X	X		X		—		—	—	X			—		—		—			—		—	
affinis							X		—				X			—			X				—							—		—	
bottae	—		—				—		—							X	—	X	X	—			X				—		—			—	
cylindrica	X	X	—	—	—		—		X				—	—	X		X	—		—			X		—		—		—	—		—	—
biloba	—	—	—	—	—		—		—			—			—	X		X	—	X			X		—							—	
lingulata	—	—	—	—	—		—		—				—		X	—	X		—	—			X		—							—	
modesta	—	—	—	—	—		—		—				—	X	X		—	—		—	X	X	—	X	—							—	—
dudleyana	—	—	—	—	—		—						X		—	—	X	—	—				—		X		—					—	
epilobioides																			X			—		X	X								
similis				—															X		—		X	X						—			
deflexa	X	—	—	—	X*		—		—	X*		—	—	—	X	X	X	X	—	—		X		X	—		—					—	
delicata																			X		X	X	X		X					X			
unguiculata	—	—	—	—	—		—		—		—	—	—			—	—	—	—	X	X		—	X		X	—		—	—		—	—
exilis																									X		—						
xantiana	—	—	—	—	—		—		—				—		—	—				—			—		—	—				—		—	—
mildrediae																													X	X			
virgata		—							—						—	—									—			X		X	—	—	
rhomboidea	—						—		—				—			—						—		X	—		—	X	X			—	—
pulchella	—*																												—			—	
concinna	—	—			—		—		—				—		—	—	—	—	—	—			—		—		—		—	—	—		
breweri																—			—						—		—			—		—	

X, at least one hybrid obtained. —, no progeny. *, Hiorth (1941).

tural rearrangement of the chromosomes which results in highly irregular meiotic behavior. This can be readily inferred from the many alloploid species in the genus that have resulted from highly sterile hybrids.

It is apparent that the various species of *Clarkia* are separated by strong barriers to gene exchange by both the infrequency and sterility of interspecific hybrids. The principal consequence of interspecific hybridization would seem to be the production of a number of alloploid species.

GENERIC LIMITS

Clarkia was erected as a genus by Pursh in 1814 to accommodate *C. pulchella,* a species with elaborately lobed and clawed petals collected by Meriwether Lewis in what is now Idaho. Subsequently, Douglas described two additional species, *C. elegans* and *C. rhomboidea* in 1833 and 1834, respectively. The petals of these species are narrowed to a conspicuous claw, but the limb is not lobed. In 1835, Spach described a separate genus *Phaeostoma* to include the species with unlobed petals. At the same time, he removed several species from *Oenothera,* primarily on the basis of flower color, and established them as the genus *Godetia*. Fischer and Meyer described *Eucharidium* in 1835, basing it on *E. concinnum.* This species has petals with 3 conspicuous lobes, as in *C. pulchella,* but it differs from the other genera in having only 4 rather than 8 stamens and an extremely long hypanthium. These genera, *Clarkia, Phaeostoma, Godetia,* and *Eucharidium,* have been variously combined by different authors (see Munz and Hitchcock, 1929), and Léveillé (1908) included all of them in *Oenothera*. The first suggestion that they should be recognized as a single genus, exclusive of *Oenothera,* was made by Nelson and Macbride (1916), who subsequently (1918) made most of the appropriate transfers. Munz and Hitchcock (1929), Hitchcock (1930), and Jepson (1907), however, recognized two genera: *Clarkia* (including *Eucharidium* and *Phaeostoma*) and *Godetia.* The criterion for distinguishing them was the lobed or conspicuously clawed petals of the former as opposed to the entire and subsessile petals of the latter. More recently, Hiorth (1941) has argued in favor of a single genus because this criterion of petal shape may have a simple genetic basis, scarcely commensurate with generic distinction.

Thus, the species described in this paper have been assigned at one time or another to five genera, and more recently to two or one. The oldest available name is *Clarkia.* The problems involved are these: to what degree the whole group is clearly distinguished from others, particularly *Oenothera* to which it bears the greatest resemblance; whether the specific interrelations within it indicate the existence of two or more readily separable taxa, which might be ranked as genera; or whether the group is a closely knit genus.

Both morphological and cytological evidence demonstrate a close relationship between *Clarkia* (*sensu lato*) and *Oenothera,* but few today would follow Léveillé in considering them congeneric, for both of them are generally distinct in aspect and are sharply distinguished by two important characters associated with their reproductive habit. *Clarkia* differs from *Oenothera* in having basifixed rather than versatile anthers, and in the disposition of the sporogenous tissue in the anthers. This is arranged in small ovoid packets separated by sterile tissue in each pollen sac of *Clarkia* and is continuous in *Oenothera.* Thus the limits of *Clarkia* are clearly defined.

The earlier classifications to which we have referred suggest the possibility of at

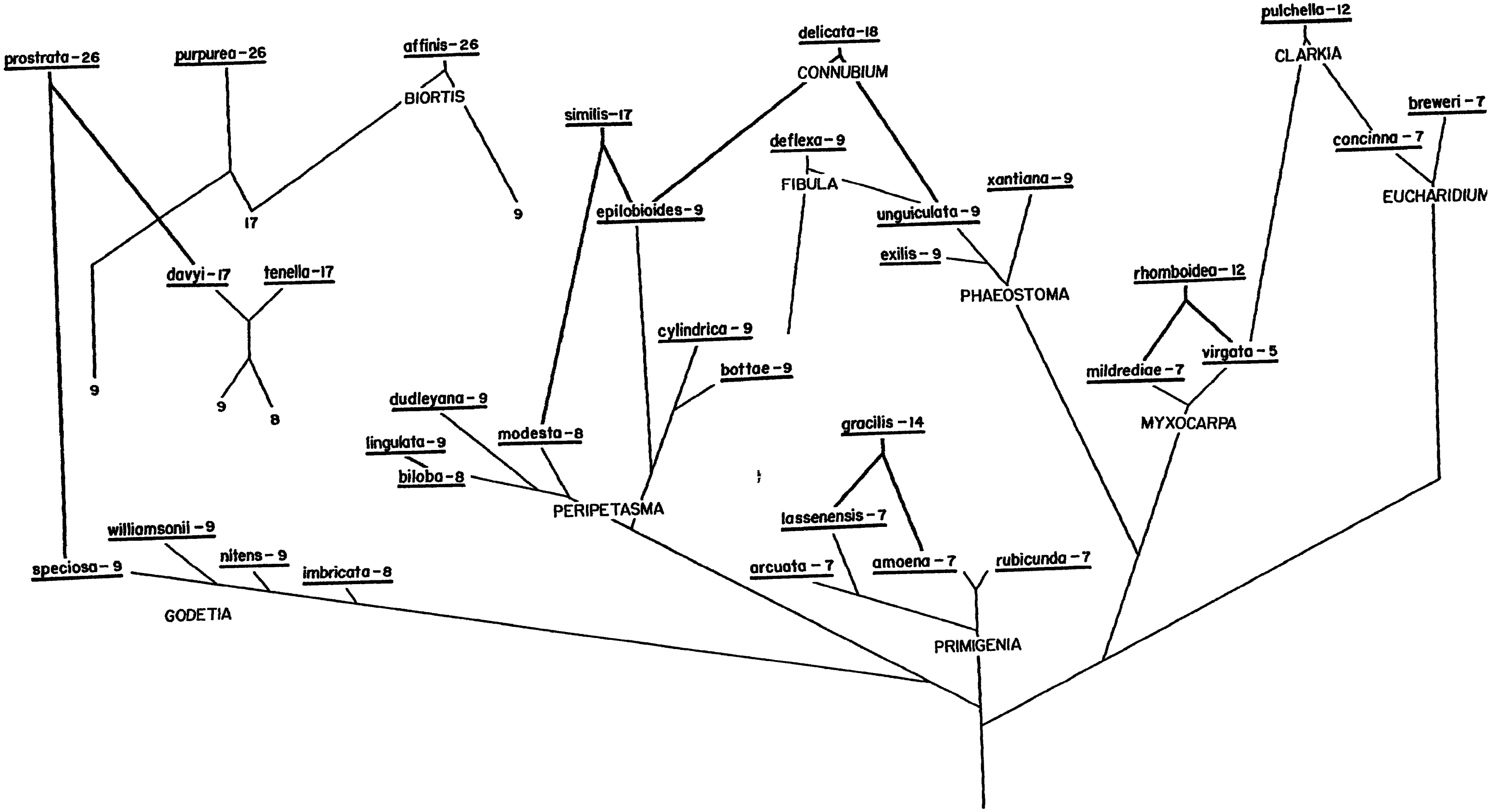

Fig. 1. Diagram of phylogenetic relationships in the genus *Clarkia*. Demonstrated relationships are indicated by heavy lines. The normal gametic chromosome number is shown for each species.

least two well-defined genera within these limits, even though Munz and Hitchcock (1929) frankly admit that their recognition of both *Clarkia* and *Godetia* was based partly on the widespread use of these names in floriculture. We have found that at least ten species groups are discernible and have designated them as sections.

The relationships of the species in each section and of the sections themselves can be inferred at present from morphological resemblances, chromosome number, and chromosome behavior in interspecific hybrids. Using these criteria, we have constructed a phylogeny which is illustrated in figure 1. Parts of this proposed phylogeny are speculative and may remain so, but many of the relationships indicated, particularly of the polyploids, have been demonstrated or can be inferred from a synthesis of morphological and cytological evidence of a sort to justify predictions which have been subsequently justified. For example, the parentage of *C. rhomboidea*, an allotetraploid species, was predicted. Morphological similarity between *C. virgata* and *C. rhomboidea* and chromosome behavior of their hybrid indicated that *C. virgata* was one of the parents. We accordingly drew up a morphological description of the hypothetical parent which should have a haploid number of 7. We later observed that specimens of the very local species recently described by Heller as *Phaeostoma mildredae* corresponded to our description, and when living material was found the expected chromosome number of 7 was verified, and the relationship subsequently demonstrated.

The relationship of the various diploid species is such that they fall conveniently into seven well-defined groups which differ by conspicuous morphological traits, and in some cases by gross differences in their chromosomes. Were these diploid species the only ones to be considered, we might wish to recognize some, if not all, of these species groups as genera. For example, the two species that are sometimes referred to the genus *Eucharidium* differ conspicuously from the remainder of the diploid species in having 4 rather than 8 stamens, a long, slender hypanthium rather than a relatively short, broad one, and conspicuous 3-lobed petals, as well as other characters. When the polyploid species are taken into account, however, it becomes evident that several of them are derived from hybrids between members of distinct species groups. If one is to recognize each of the parental groups as a genus, the problem arises as to the proper taxonomic disposition of the polyploid. An arbitrary assignment of the polyploid to one or the other parental group is misleading inasmuch as it is obviously equally related to both. The polyploid species could be recognized as a monotypic genus derived from two others, but this would not only result in an unnecessary multiplication of generic names but also obscure the relationship of the derived species. The alternative, and to us the only reasonable course to follow, has been to retain the polyploid and the species groups from which it has been derived in the same genus. If one accepts this reasoning, it follows that at most only four constellations of species within *Clarkia* (*sensu lato*) could be recognized as separate genera. One would include only our Section Primigenia, another only Section Fibula. A third would be comprised of Section Godetia, Section Peripetasma, Section Phaeostoma, and the polyploid sections derived from them. The fourth would consist of Section Eucharidium, Section Myxocarpa, and the alloploid Section Clarkia. But the relationship between these four groups is as close as the relationship between groups of species included within the two larger constellations. For example, Section Fibula is morphologically intermediate between Section Peripetasma and Section Phaeostoma and is almost certainly more closely related to each of these sections than they are to each other. Yet the relationship of Phaeostoma to Peripetasma is not only indicated by the alloploid Section Connubium but by the degree of chromosome homology indicated by meiosis in the hybrid between *C. dudleyana* (Peripetasma) and *C. unguiculata* (Phaeostoma). At the same time, the morphological distinction between Section Primigenia and Section Peripetasma is certainly no greater than that which distinguishes Peripetasma from Phaeostoma. Consequently, to exclude either Fibula or Primigenia from the constellation which includes Section Peripetasma, Section Phaeostoma, and Section Godetia would be to ignore obvious relationships as indicated by a summation of morphological and cytological evidence.

The relationship of the constellation of species groups which includes our sections Myxocarpa, Eucharidium, and Clarkia, to the group indicated above, is also close. A summation of morphological traits indicates unequivocally that Section Myxocarpa is as closely related, if not more so, to Section Primigenia and perhaps Phaeostoma as it is to Eucharidium, to which it is united by alloploidy. Furthermore, the hybrid between *C. rhomboidea* (Myxocarpa) and *C. delicata* (Connubium) is as readily obtained as other intersectional hybrids.

Thus, the evidence from morphology, chromosome homology, and the demonstrable origin of alloploids shows beyond doubt that *Clarkia* is a genus of several diverse species groups which are closely knit into a reticulate pattern of relationship. Generic segregation will produce a classification which is misleading if its object is to indicate an evolutionary process. Our more extensive data, accordingly, confirm the views of Nelson and Macbride (1916) and of Hiorth (1941) that only one genus should be recognized.

SPECIES DELIMITATION

The species recognized in this paper are morphologically distinguishable and are separated by strong barriers to gene exchange. Many of these barriers have been demonstrated by hybridizing different taxa. Some crosses have produced no offspring, and others have produced only sterile, or nearly sterile, progeny. Other barriers have been inferred from sympatric association in nature. The specific limits we have drawn seem, therefore, to be well established on both morphological and genetical grounds.

These limits could be restricted further in some taxa, because some populations within them are reproductively isolated. For example, repeated attempts to cross certain populations of *C. deflexa* have failed to produce viable progeny. Crosses between other populations of the same taxon have produced sterile progeny (Lewis, 1953*a*). This is also true of *C. dudleyana*. Such reproductively isolated populations can usually be distinguished morphologically, at least when grown under uniform or comparable conditions, but the differences which distinguish them are no greater and are often less than those between populations which cross freely and produce fully fertile progeny. Furthermore, all degrees exist between sterile and fully fertile crosses. In other words, one can not predict the degree of compatibility between populations from the degree of morphological resemblance between them. Under these circumstances, the delimitation of taxa by means of reproductive barriers becomes as arbitrary as delimitation by morphological criteria alone. We have made no attempt to apply a formal taxonomy to these intersterile populations because to

produce a usable classification

Differences of breeding habit within a genus may also affect the relation between formal taxonomy and its use as a means of indicating relationships. Some of the taxa we have recognized are consistently outcrossed; others include both self-pollinating and outcrossing races. In the first instance, the result is sometimes a series of allopatric races of which some are sufficiently recognizable to be treated as subspecies. In the second instance, one may find allopatric differentiation of varying degrees and coupled with it, particularly in some localities, several sympatric races which are sharply defined morphologically and are separated by strong barriers to gene exchange due to self-pollination. Each of the latter might be distinguished taxonomically, perhaps as a species, if the distinctions did not break down in other localities as a result of occasional outcrossing. To apply a formal nomenclature to such races would be an endless and, in our opinion, a useless task. We have, accordingly, recognized as subspecies the better-defined allopatric races of outcrossing species, and the principal morphological modes of those which include self-pollinating races.

TAXONOMY

Clarkia Pursh, Fl. Am. Sept. 1: 260, pl. 11. 1814.

Annual herbs; stems slender or stout, as much as 2 cm. in diameter, the epidermis usually exfoliating near the base; leaves pinnately simple, linear to elliptic or ovate, entire or denticulate, sessile or the petioles short, sometimes as long as the blade; inflorescence a leafy spike or raceme; rachis of the inflorescence straight or recurved in bud; buds erect, deflexed, or pendulous; flowers usually conspicuous, 1–10 cm. in diameter, abscissing at the base of the hypanthium after fertilization; hypanthium obconical, funnelform, campanulate, or elongated and slender, usually with a ring of hairs within; sepals 4, often colored, reflexed individually, in pairs, or remaining united and deflexed to one side at anthesis; petals 4, oblanceolate to obovate, or fan-shaped, frequently lobed or clawed, lavender or pink to dark reddish-purple, sometimes yellow or white, often spotted, flecked or streaked with red or white; stamens 8 in two series, or reduced to one series of 4; filaments filiform to clavate, sometimes subtended by hairy scales; anthers basifixed, obtuse or with a short acute sterile tip, the sporogenous tissue of each anther sac separated into small packets by sterile tissue; pollen white, yellow, blue, or reddish, usually 3-lobed; stigma 4-lobed, the lobes short or elongate, slender or broad and overlapping, white or yellow to dark purple or red; style shorter or longer than the stamens; ovary variously pubescent, cylindrical, or spindle-shaped, sometimes clavate, terete or more frequently 4- or 8-grooved and often deeply 8-ribbed, sessile or on a conspicuous pedicel; capsule terete to quadrangular, beakless or long-beaked, often tardily dehiscent; seeds tan to dark brown or often gray, scaly or minutely tuberculate, usually angular, cubical or elongate, usually oblique, sometimes spindle-shaped, characteristically with a crest of elongated cells.

Type species.– *C. pulchella* Pursh.

Clarckia Pursh,[1] Fl. Am. Sept. 1: 260, pl. 11. 1814. ***Eucharidium***, as a genus, Fischer & Meyer, Ind. Sem. Hort. Petrop. 2: 36. 1835; as a subgenus, Jepson, Fl. W. Mid. Calif. 331. 1901. ***Phaeostoma***, as a genus, Spach, Hist. Veg. Phan. 4: 392. 1835; as a subgenus, Munz & Hitchcock, Bull. Torrey Bot. Club 56: 187. 1929. *Godetia*, as a genus, Spach, Hist. Veg. Phan. 4: 386; as a section of *Oenothera*, Torrey & Gray, Fl. N. Am. 1: 502. 1840. *?Opsianthes*, as genus, Lilja, Fl. Sverig. Suppl. 25. 1840. We have been unable to examine the original reference to *Opsianthes*. Munz and Hitchcock (Bull. Torrey Bot. Club 56: 189) and Index Kewensis, however, refer this genus to synonymy with *Clarkia*.

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[1] The original spelling has not been retained because the genus was unquestionably named for Captain William Clark of the Lewis and Clark Expedition, and the insertion of the extra c was certainly an unintentional error.

KEY TO THE SPECIES

I. South American species..10. *C. tenella*

II. North American species

A. Stamens 4; hypanthium slender, 1.5 cm. long or longer; petals conspicuously 3-lobed.

B. Petals about as long as broad, the middle lobe much narrower than the outer; sepals reflexing near the base, not petaloid....................33. *C. breweri*

BB. Petals about twice as long as broad, the middle lobe more or less equaling the outer in breadth; sepals reflexing near the middle, the lower half petaloid.......32. *C. concinna*

AA. Stamens 8 (4 may be sterile); hypanthium campanulate, funnelform, or obconical, usually less than 1.5 cm. long.

B. Limb of the petals conspicuously lobed.

C. Petals 2-lobed.

D. Petals with a prominent tooth 1–3 mm. long in the sinus........27. *C. xantiana*

DD. Petals without a tooth in the sinus.................................17. *C. biloba*

CC. Petals 3-lobed

D. The middle lobe of the petal prominent, larger than the lateral lobes.

E. Fertile stamens 4, the inner anthers sterile, greatly reduced....31. *C. pulchella*

EE. Fertile stamens 8, the inner anthers fertile, not greatly reduced...30. *C. rhomboidea*

DD. The middle lobe of the petal 1–3 mm. long consisting of a tooth within the sinus of the otherwise 2-lobed petal........................27. *C. xantiana*

BB. Limb of the petals entire to erose or emarginate, not conspicuously lobed.

C. Rachis of the inflorescence reflexed, becoming straight as the buds mature.

D. Petals constricted into a claw which is expanded into a pair of lateral teeth or lobes near the base.

E. Rachis of the inflorescence becoming erect as the flowers open, or at most 2 or 3 nodes above the uppermost flower; leaves ovate to elliptical or lanceolate; petals usually purplish-red or pink; anthers lavender to red.

F. Petals 6–12 mm. long, 3–7 mm. broad; plants of wide distribution 30. *C. rhomboidea*

FF. Petals 14–21 mm. long, 10–14 mm. broad; plants local in Butte, Plumas, and Shasta counties, California...........................28. *C. mildrediae*

EE. Rachis of the inflorescence becoming erect well in advance of anthesis, 4 to 6 or more nodes above the uppermost flower; leaves lanceolate to narrowly lanceolate; petals purple to lavender; anthers usually dark purple; plants of the central Sierra Nevada foothills..29. *C. virgata*

DD. Petals not constricted into a definite claw or if so the claw entire.

E. Petals white to pale cream, unmarked, fading pink, usually less than 10 mm. long 21. *C. epilobioides*

EE. Petals colored or if nearly white then flecked with purple, usually more than 10 mm. long.

F. Ring of hairs within the hypanthium at or near the summit or absent; hypanthium 1–3 (rarely 4) mm. long.

G. Immature capsules 4-grooved or the grooves obscure.

H. Pollen yellow; petals usually less than 1 cm. long, more or less uniformly lavender pink.....................................5a. *C. gracilis gracilis*

HH. Pollen blue to cream; petals usually exceeding 1 cm. in length, pinkish-lavender above, with a broad band of white below, often lavender near the base..15. *C. bottae*

GG. Immature capsules 8-grooved, ribbed, or striate.

H. Immature capsules conspicuously 8-ribbed, bright green and shining; petals 10–25 mm. long; stigma at maturity elevated above the stamens.

I. Petals oblanceolate, 2–3 times as long as broad, bright pink; plants local in Mariposa County, California............................18. *C. lingulata*

II. Petals obovate, not greatly longer than broad, lavender-pink.

J. Petals usually streaked with white; plants of southern California and the Sierra Nevada foothills south of Tuolumne County.....20. *C. dudleyana*

JJ. Petals not streaked with white; Sierra Nevada foothills north of Amador County .. ..17*c*. *C. biloba brandegeae*

HH. Immature capsules shallowly 8-grooved, dull green; petals 6–12 mm. long; stigma at maturity usually not elevated above the stamens.

I. Petals pink, often with reddish-purple flecks near the base; plants of the Coast Ranges, California, and southern Sierra Nevada foothills 19. *C. modesta*

II. Petals pale pink or nearly white, flecked with reddish purple in the lower half; plants of the South Coast Ranges and southern California 22. *C. similis*

FF. Ring of hairs within the hypanthium obviously below the upper margin, usually near the middle or in the lower half; hypanthium usually 3 mm. long or longer.

G. Anthers similar in size and color; pollen uniform in color, yellow to nearly white; petals not flecked with red; plants of Oregon, Nevada, Washington, and the northern half of California.

H. Immature capsules 8-grooved or ribbed, cylindrical or largest at the middle.

I. Immature capsules bright green and shining, tapering to a slender beak as much as 7 mm. long; pedicels at maturity 5–15 mm. long; petals 10–30 mm. long.. ....3. *C. arcuata*

II. Immature capsules dull green, tapering to the summit or with a beak rarely exceeding 3 mm., sessile or on pedicels not exceeding 3 mm.; petals 8–16 mm. long...4. *C. lassenensis*

HH. Immature capsules 4-grooved, usually largest above the middle 5. *C. gracilis*

GG. Anthers of the two series differing in color, size, or both; pollen of at least the outer series normally blue or bluish, the inner lighter, often cream; petals often flecked with red or purple; plants of central and southern California

H. Petals oblanceolate, uniformly bright pink; plants local in Mariposa County, California ... .18. *C. lingulata*

HH. Petals obovate to fan-shaped, pinkish-lavender or purple in the upper half, white or lighter below, the base usually dark red-purple...16. *C. cylindrica*

CC. Rachis of the inflorescence straight, the buds erect or deflexed.

D. Buds, at least the older ones, deflexed; stems glaucous and glabrous, sometimes puberulent above.

E. Petals with a distinct slender claw equal to or exceeding the limb.

F. Petals usually less than 10 mm. long, the blade rhomboid; style equaling the stamens; ovary at anthesis equaling the combined length of the hypanthium and sepals; plants local in Kern and Tulare counties, California...... 26. *C. exilis*

FF. Petals usually more than 10 mm. long, the blade usually deltoid to semicircular; style exceeding the stamens; ovary at anthesis shorter than the combined length of hypanthium and sepals; plants of wide distribution in California 25. *C. unguiculata*

EE. Petals without a slender claw, spatulate to obovate or fan-shaped.

F. Petals obovate to spatulate, 8–12 mm. long; anthers of the longer stamens bright orange; plants of San Diego County, California...............24. *C. delicata*

FF. Petals shield-shaped, 10–30 mm. long, usually about as broad as long; anthers of the longer stamens usually lavender with blue pollen; plants of Orange County to Monterey County, California...............................23. *C. deflexa*

DD. Buds erect; stems not glaucous, puberulent at least above.

E. Mature stigma elevated above the stamens; petals usually exceeding 15 mm. in length.

F. Immature capsules 4-grooved, the grooves sometimes obscure.

G. Petals lavender to pinkish-lavender usually with a bright-red base; plants of Monterey County to southern Marin County, California......2. *C. rubicunda*

GG. Petals lavender to pink or nearly white, usually with a red blotch or penciling in the center, the base sometimes darker but not red; plants of Marin County, California, to British Columbia........ ....1. *C. amoena*

FF. Immature capsules conspicuously 8-grooved or ribbed.

G. Petals with a red or purple spot.

H. Petals with a wedge- or shield-shaped spot above the middle that often becomes diffuse or obscure near the upper margin.

I. Leaves lanceolate, less than 5 times as long as broad, over-lapping; hypanthium about 15 mm. long, 10 mm. broad, conspicuously veined; plants of Sonoma County, California .. ..6. *C. imbricata*

II. Leaves linear to narrowly lanceolate, at least 5 times as long as broad, not conspicuously overlapping; hypanthium 5–13 mm. long, less than 10 mm. broad, not conspicuously veined.

J. Buds mucronate, the tips of the sepals free; plants of the central Sierra Nevada foothills.. .. ..7. *C. williamsonii*

JJ. Buds not mucronate, the tips of the sepals usually fused; plants of wide distribution... ....13. *C. purpurea*

HH. Petals with an ovate, semicircular, or crescent-shaped spot in the center or toward the base.

I. Capsules conspicuously enlarged at the middle; plants of coastal Mendocino and Humboldt counties, California ....1c. *C. amoena whitneyi*

II. Capsules not conspicuously enlarged at the middle; plants of the Sierra Nevada foothills and South Coast Ranges of California.

J. Flowers congested; ovary longer than the internode above; plants of the central Sierra Nevada foothills ....8. *C. nitens*

JJ. Flowers not congested; ovary usually shorter than the internode above; plants of the South Coast Ranges, Tehachapi Mountains, and foothills of the southern Sierra Nevada ... .9. *C. speciosa*

GG. Petals not spotted, sometimes darker in the center.

H. Ovary puberulent with short upwardly curled hairs.

I. Petals dark reddish-purple; sepals reflexed individually; plants of the central Sierra Nevada .. ..7. *C. williamsonii incerta*

II. Petals bright pink or lavender, sometimes cream in the lower half; sepals usually remaining united or deflexed in pairs, rarely reflexed individually.

J. Flowers crowded; ovary longer than the internode above; plants of the central Sierra Nevada foothills .. ..8. *C. nitens*

JJ. Flowers not crowded; ovary usually shorter than the internode above; plants of the South Coast Ranges, California .. .. 9. *C. speciosa*

HH. Ovary usually densely pubescent with spreading hairs.....13. *C. purpurea*

EE. Mature stigma not elevated above the stamens; stamens often adhering to the stigma; petals usually less than 15 mm. long.

F. Immature capsules 4-grooved, the grooves often obscure; plants of coastal Oregon to Vancouver Island, B.C...... ....1e. *C. amoena caurina*

FF. Immature capsules conspicuously 8-grooved or ribbed.

G. Plants of the sea coast; usually prostrate or decumbent; leaves oblanceolate to elliptic or obovate, the apex usually obtuse.

H. Petals 5–11 mm. long, lavender-pink shading to cream below, unspotted; plants of San Francisco Peninsula to Humboldt County, California. 11. *C. davyi*

HH. Petals 10–15 mm. long, lavender-pink shading to cream or yellow below, usually with a reddish spot at the junction of the two colors; plants of Santa Cruz, Monterey, San Luis Obispo, and Santa Barbara counties, California 12. *C. prostrata*

GG. Plants of the interior away from the immediate coast; usually erect; leaves linear to elliptic or ovate, the apex acute.

H. Immature capsules slender, 8-grooved, usually at least 10 times as long as broad, at maturity tapering to a slender beak 3–7 mm. long; sepals usually remaining united and deflexed to one side; plants of the Coast Ranges, California .... .14. *C. affinis*

HH. Immature capsules stout, 8-ribbed, not more than 8 times as long as broad, tapering to the summit or with a short beak as much as 2 mm. long; sepals usually reflexing individually or in pairs; plants of wide distribution 13. *C. purpurea*

Section Primigenia sec. nov.

Herbae erectae vel prostratae; caulibus pubescentibus vel subglabris; inflorescentium axe recto vel in apice recurvato; calycis tubo obconico, 1.5–10 mm. longo, annulo pilorum vel sine pilo; calycis limbo sub anthesi connato et declinato; petalis obovatis vel flabelliformis, unguiculis summe brevis vel inconspicuis; staminibus 8, circulis duo similibus; antheris acutis vel mucronatis; filamentis crassis et erectis; ovario 4-canaliculato vel 8-costato.

Erect or prostrate herbs; stems puberulent to glabrate; rachis of the inflorescence straight or recurved in bud; hypanthium obconical, 1.5–10 mm. long, with or without a ring of hairs within; sepals remaining united and deflexed to one side at anthesis; petals obovate to fan-shaped, the claw inconspicuous or absent; stamens 8, in two similar series; anthers acute or mucronate; filaments stout, erect; immature capsules 4-grooved or 8-ribbed.

Type species.—*C. amoena* (Lehmann) Nelson and Macbride.

Section Primigenia is comprised of three well-defined subsections: (1) Primigenia, including *C. amoena* and *C. rubicunda;* (2) Flexicaules, including *C. arcuata* and *C. lassenensis;* (3) Jugales, consisting of *C. gracilis.* The first two subsections are comprised of diploid species; the third consists of an allotetraploid species which combines genomes and morphological characters of the other two. Subsection Primigenia occurs along the coast and inland through the coastal ranges. It is characterized morphologically by inflorescences with a straight rachis, erect buds, and immature capsules that are usually 4-grooved. Subsection Flexicaules is more interior than Primigenia, although the two groups overlap in one small area in northern California. The former is characterized by a strongly recurved rachis with pendulous buds and immature capsules that are 8-ribbed or grooved. The alloploid Subsection Jugales is sympatric with the other subsections over a wide area.

Relationship.—The diploid species of Section Primigenia are probably closest to the ancestral type of the genus on the basis of morphology, including the karyotypes. Species similar to those in this section were probably directly ancestral to sections Godetia and Peripetasma, and perhaps to a line of descent from which sections Myxocarpa and Eucharidium have been derived.

SUBSECTION PRIMIGENIA

Rachis of the inflorescence straight; buds erect; ovary and immature capsules usually 4-grooved.

1. **Clarkia amoena** (Lehmann) Nelson and Macbride, Bot. Gaz. 65: 62. 1918. (Fig. 3, *a*, *b*, *c*.)

Erect or decumbent, as much as 2 m. tall; stems simple or branched, more or less puberulent above with short, upwardly curled hairs, glabrate to sparsely puberulent below; leaf blades linear to lanceolate, entire to denticulate, 1-6 cm. long, 2–10 (15) mm. broad, glabrate to sparsely puberulent, narrowed to petioles as much as 1 cm. long; rachis of the inflorescence erect; buds erect; hypanthium 3-10 mm. long, white to lavender within, the ring of hairs below the middle; sepals lanceolate, 10-30 (33) mm. long, 2-5 mm. broad, united and deflexed to one side at anthesis, rarely reflexed in pairs or individually; petals obovate to fan-shaped, 1–6 cm. long, subentire to erose, sometimes emarginate, pink to lavender, sometimes darker or shading to white at the base, usually blotched or penciled in the center with bright red; stamens 8; filaments white to lavender; anthers acute, usually with slender tips as much as 1 mm. long, lavender to yellow, often spotted or streaked with red; pollen yellow or cream-colored; stigma white to pale yellow, the lobes linear; style white to lavender, longer or shorter than the stamens; ovary puberulent, 1–3 cm. long, sessile or on a pedicel as much as 13 mm. long; immature capsule 4- or 8-grooved, slender or conspicuously enlarged near the middle, sometimes largest in the upper half, 1.5–4 cm. long, 2–10 mm. broad, scarcely beaked or the beak as much as 4 mm. long; mature capsule slender or spindle-shaped, subterete, 1.5-5 mm. broad; seeds brown or grayish, scaly, 1–1.5 mm. long, the crest scarcely 0.1 mm. long.

Type.—Based on *Oenothera amoena* Lehmann.

A specimen at Kew (Herbarium Hookerianum) sent by Lehmann can be taken as a lectotype (see Jepson, 1907, p. 328). The color pattern, however, has completely disappeared from this specimen, and the precise locality of the original seed source is not known. This specimen could be assigned either to the species described here or to the closely related *C. rubicunda*. Furthermore, the original description is not definitive. Lehmann, however, published a colored illustration (Pugillus Plantarum 1: 811. 1828) of his *Oenothera amoena.* This illustration shows a plant with white petals with a pink base and a red central spot. Since *C. rubicunda* is not known to have a central spot in natural populations, the plant illustrated by Lehmann cannot represent this species. This illustration is like our collections of *C. amoena* from Bodega Bay, Sonoma County, California, and the original seeds may have come from this place.

Clarkia amoena is one of the most variable species in the genus. The variation in natural populations includes differences in habit, vegetative characters, flower size, color and color pattern, petal shape, capsule size and shape, ecology, and degree of self-pollination. Part of the variation, but assuredly not all, may be due to recent hybridization with cultivated strains of this same species. Some differences, such as flower color and color pattern are sporadic or characterize particular colonies. Others have a characteristic geographical expression. We have recognized five modal expressions of this geographical variation as subspecies. They are all interfertile (Hiorth, 1942*a*), and morphological intermediates between them are frequent. Each has the same basic chromosome number (n = 7) except for a rare genome of 6 in *C. amoena huntiana* (Håkansson, 1942).

KEY TO THE SUBSPECIES

A. Mature stigma not held above the stamens; petals mostly less than 2 cm. long; plants of coastal Oregon, Washington, and Vancouver Island.................... 1*e*. subsp. *caurina*

AA. Mature stigma held above the stamens; petals mostly more than 2 cm. long.

  B. Immature capsules 8-grooved, conspicuously enlarged at the middle, about 10 mm. broad; local in coastal Mendocino and Humboldt counties, California...... . 1*c*. subsp. *whitneyi*

  BB. Immature capsules 4-grooved, more slender, less than 5 mm. broad, cylindrical or sometimes somewhat enlarged at the middle or above.

    C. Plants coarse; inflorescence more or less congested, the internodes usually shorter than the subtending ovary.

      D. Plants erect, as much as 2 m. tall; interior Oregon and Washington. . 1*d*. subsp. *lindleyi*

      DD. Plants often sprawling, usually less than 1 m. tall, coastal Marin, Sonoma, Humboldt, and Mendocino counties, California.......................... . 1*a*. subsp. *amoena*

    CC. Plants slender; inflorescence lax, the internodes longer than the subtending ovary; North Coast Ranges of California to southern Oregon.................. 1*b*. subsp. *huntiana*

1*a*. Clarkia amoena subsp. amoena

Coarse, sprawling or erect, usually less than 1 m. tall; leaf blades lanceolate, 1–6 cm. long, 4–15 mm broad; flowers more or less congested; hypanthium 6–10 mm. long; petals obovate to fan-shaped, 20–35 mm. long, pink or lavender to white above, often pink or lavender at the base, usually penciled or blotched in the center with bright red; mature style longer than the stamens; immature capsule 4-grooved, slender, not conspicuously enlarged near the middle, usually equaling or exceeding the length of the internode above.

Oenothera amoena Lehm., Ind. Sem. Hort. Hamb. 8. 1821. *Godetia lehmanniana* Spach, Nouv. Ann. Mus. Par. III, 4: 392. 1835. *Godetia amoena* Don, *in* Sweet, Hort. Brit. ed. 3, 237. 1839. *Oenothera prismatica* var. *amoena* Lév., Monog. Onoth. 266. 1908.

Oenothera roseo-alba Bern., Ind. Sem. Hort. Erford. 1828. Placed in synonomy on basis of illustration in Sweet. Brit. Fl. Gard. t. 268. 1828.

Godetia vinosa Lindl., Bot. Reg. 22: t. 1880. 1836. Type collected in California by *Douglas* (Lindley Herbarium). *Oenothera vinosa* Torr. & Gray, Fl. N. Am. 1: 503. 1840.

Godetia nivertiana Gaujon, Rev. Hortic. 431. 1872. Placed in synonomy on basis of illustration.

Distribution (see fig. 2).—CALIFORNIA. Coastal areas of Humboldt, Marin, Mendocino, and Sonoma counties. Common in scattered colonies near the coast where it frequently occurs on steep, west-facing, grassy slopes. It is often found on the sea bluffs.

Representative specimens.—CALIFORNIA. Humboldt County: Cape Mendocino, *Tracy 15957*; Domingo Gulch on road from Petrolia to Cape Mendocino, *Harris 671*. Marin County: Olema, *Elmer 4939*; Point Reyes Peninsula, 0.25 mile from lighthouse, *Wolf 5780*; 0.5 mile from Tomales on road to Tomales Bay, *Wolf 5796*. Mendocino County: 6.8 miles south of Pt. Arena, *Wolf 5806*; Highway 1, 5.7 miles south of Fort Ross Historical Monument, *Lewis & Lewis 434*. Sonoma County: Bodega Point, *Eastwood 4883*; Bodega Bay at road to Doran Park, *Lewis & Lewis 436*.

The Humboldt County populations of subspecies *amoena* are separated from those further south by an area occupied by subspecies *whitneyi* and *huntiana*. This may indicate a separate origin of two morphologically similar coastal ecotypes or fragmentation of a once-continuous distribution.

We have examined natural populations of this subspecies throughout its area of distribution, but we have not grown progenies in the experimental garden. However, progenies from four populations of this subspecies were grown by Hiorth (1942*a*) derived from seeds from Pt. Arena in Mendocino County, Occidental, Bodega, and Bodega Bay in Sonoma County, and these retained their characteristic traits under cultivation. A progeny grown by him from seeds from Tocaloma in Marin County may have been intermediate between subspecies *amoena* and subspecies *huntiana* but is discussed by us under the latter.

The haploid chromosome number is 7 (Håkansson, 1942), based upon microsporocyte examination of ten individuals from two populations (Occidental and Bodega Bay). Our determinations, from one population, *436*, Bodega Bay at road to Doran Park, are in agreement. Håkansson (1942) found half of the individuals examined to be translocation heterozygotes which formed a ring of 4 or 6 chromosomes.

Fertile hybrids between *C. amoena amoena* and populations referable to subspecies *caurina*, subspecies *huntiana*, and subspecies *lindleyi* were produced by Hiorth (1942*a*). Meiosis of four of the hybrids involving three different crosses was examined by Håkansson (1942). In all instances, the hybrids were structurally heterozygous, but the number of individuals was too small to indicate whether or not consistent differences in chromosome arrangement will be found between these subspecies.

Populations intermediate between subspecies *amoena* and subspecies *whitneyi* are found in Humboldt County (e.g., Shelter Cove, *Tracy 4998*, in part) while populations intermediate with subspecies *huntiana* are frequent over the wide area in which the two subspecies are in contact (e.g., Marin County, Tocaloma, *Keck 4580*).

Subspecies *amoena* was the first of this species to be introduced into cultivation and has contributed to many of the present cultivated strains.

1*b*. **Clarkia amoena** subsp. **huntiana** (Jepson) Lewis & Lewis comb. nov. (Fig. 3, *a*, *b*.)

Slender, often much branched, as much as a meter tall; leaves linear to lanceolate, 2–5 cm. long, 2–5 mm. broad; inflorescence lax; hypanthium 4–10 mm. long; petals obovate to fan-shaped, 15–30 mm. long, lavender, usually with a bright-red blotch in the center; mature style longer than the stamens; immature capsule slender, sometimes somewhat enlarged above, 1.5–3 cm. long, 2–4 mm. broad, 4-grooved, the grooves sometimes inconspicuous; mature capsule usually much shorter than the internode above.

Type.—Based on the type of *Godetia amoena* f. *huntiana* Jeps. Blue Lakes, Lake County, California, *Jepson & L. E. Hunt*, July 16, 1897, later numbered *13336* (Jepson Herbarium).

Godetia amoena f. *huntiana* Jeps., U.C. Publ. Bot. 2: 329. 1907. *Godetia amoena* var. *huntiana* Jepson, Man. Fl. Pl. Cal. 677. 1925.

Distribution (see fig. 2).—CALIFORNIA. Colusa, Del Norte, Humboldt, Lake, Marin, Mendocino, Napa, Sonoma, and Trinity counties. OREGON. Curry, Jackson, and Josephine counties. Common throughout the North Coast Ranges of California away from the immediate coast. It is most frequent in open, often grassy, sites in the coastal forest, particularly where the woodland and coastal forest interdigitate.

Representative specimens.—CALIFORNIA. Del Norte County: Smith River, mouth of Mill Creek, *Abrams 8431;* northeast of Crescent City, *Mathias 768.* Humboldt County: Table Bluff, *Tracy 3790;* Wildcat Ridge near Mt. Glen, *Kildale 2367.* Lake County: between Bartlett Springs and Allen Springs, *Heller 12375;* Kelseyville, *Abrams 12326.* Mendocino County: Bluffs south of Albion, *Heller 15317.* Sonoma County: Glen Ellen, *Brandegee* in 1908. Trinity County: 60 miles east of Arcata, *Hitchcock & Martin 5420.*

Progenies from the following localities have been studied in the experimental garden. Colusa County: Highway 20, 3 miles east of Colusa County line, *67.* Lake County: Highway 20, 18 miles east of U.S. Highway 101, *76;* 2.2 miles east of Bartlett Springs, *887.* Mendocino County: 6.3 miles west of Lake County line on road to Hopland, *80*; 7.8 miles north of Willets city limit, *85;* Willets, hill opposite Veterans Memorial, *98;* U.S. Highway 101, 5.4 miles south of Hopland-Lakeport Road, *135;* U.S. Highway 101, 3.7 miles south of Mendocino County line, *426.* Sonoma County: 2 miles east of Mark West Spring, *871;* 4 miles west of Mark West Spring, *866.*

The normal haploid chromosome number is 7. We have examined material from two populations, *426* and *877*. Our observations are in agreement with the determinations of Håkansson (1942) for thirty-four individuals from eleven populations of this subspecies (Humboldt County: Horse Mountain, Bear River Road, Monument, Wildcat Road, and Buck Mountain. Mendocino County: Willits, Cloverdale 2, Santa Rosa 6 and 7. Marin County: Tocaloma. Napa County: Oakville). This subspecies has the greatest degree of structural heterozygosity known in the genus. Håkansson found in addition to structural homozygotes, individuals which produced rings of 4, 6, 8, 10, and 12, two rings of 4, and a ring of 6 plus a ring of 4. Furthermore, several individuals were found in five populations with a total of 13 chromosomes, combining a genome of 7 and one of 6. Individuals homozygous for a genome of 6 have not been found in nature. In the experimental garden, these homozygotes either do not survive or are sterile (Hiorth, 1948*b*; Håkansson, 1945*b*).

Numerous hybrids between subspecies *huntiana* and each of the others were obtained by Hiorth (1942*a*). In one cross with subspecies *caurina* (Tocaloma × Sooke), several individuals were sterile or nearly so. Other combinations, however, including those involving subspecies *caurina*, were found to be fertile. A number of the hybrids produced were examined cytologically by Håkansson (1942) and proved to be as heterozygous for translocations as would be expected on the basis of the large number of chromosome arrangements within the species. In addition to the expected translocation heterozygotes, an inversion was found in a hybrid between *C. amoena huntiana* (Wildcat Road) and *C. amoena lindleyi* (Kelso, Washington).

Populations which are morphologically intermediate between subspecies *huntiana* and subspecies *lindleyi* are frequent in southern Oregon (e.g., Jackson County, 1 mile north of Baker Camp, 12 miles north of Trail, *Hitchcock & Martin 5012*) and northern California as far south as Humboldt County (e.g., Bug Creek, *Kildale 3749, 5699;* mouth of Grizzly Creek on Van Duzen River, *Abrams 6020*). Intermediates between subspecies *huntiana* and *whitneyi* are found in coastal Humboldt and Mendocino counties (e.g., 8 miles north of Rockport, *Hitchcock & Martin 5430*), while intermediates with subspecies *amoena* also occur, as indicated above.

Clarkia amoena huntiana apparently has not contributed to present cultivated strains.

1*c*. **Clarkia amoena** subsp. **whitneyi** (Gray) Lewis & Lewis comb. nov.
(Fig. 3, *c*.)

Coarse, often branched and sprawling, less than a meter tall, leaves lanceolate, 2–5 cm. long, 5–15 mm. broad; inflorescence congested; flowers exceptionally large and showy except in depauperate plants, hypanthium 5–10 mm. long; petals fan-shaped, as much as 6 cm. long, lavender, somewhat lighter below, with a bright-red spot in the center; mature style exceeding the stamens; immature capsule jug-shaped, conspicuously enlarged at the middle, about 2 cm. long and often 10 mm. or more broad, 8-grooved, the 4 primary grooves more prominent.

Type.—Based upon the type of *Oenothera whitneyi* Gray. Plains at Shelter Cove, Humboldt County, California, *Bolander 6534* (Gray Herbarium).

Oenothera whitneyi Gray, Proc. Am. Acad. 7: 340. 1865. *Godetia whitneyi* Moore, Flor. & Pomol. 101. 1871. *Clarkia whitneyi* Nelson & Macbride, Bot. Gaz. 65: 61. 1918, *in adnot. Oenothera auricula* var. *whitneyi* Lév. Monog. Onoth. 270. 1908.

Distribution (see fig. 2). CALIFORNIA. Known only from a few localities along the coast in Humboldt and northern Mendocino counties.

Specimens examined. CALIFORNIA. Humboldt County: Shelter Cove, *Bolander 6534; Tracy 4998* (in part); 1 mile east of Shelter Cove, *Hitchcock and Martin 5432* (capsules rather slender); about 1.5 miles west of Fortuna, *Harris 3485*. Mendocino County: coast at Ten-mile River, *Peirson 3792;* north side of mouth of San Juan Creek, 6.1 miles north of Westport, *Wolf 5817; Lewis & Lewis 428;* Rockport, *Jones 28987*.

We have grown material in the experimental garden from San Juan Creek, Mendocino County, *428*. Several plants from this population were found to have a somatic chromosome number of 14, which is in agreement with the determination of Håkansson (1942) on a plant from Shelter Cove. Microsporocytes of the latter had a ring of 6 and 4 pairs. Material from Shelter Cove has been crossed to several populations of subspecies *huntiana* and the hybrids produced were fertile (Hiorth 1942*a*).

Collections intermediate between subspecies *whitneyi* and *huntiana* on the one hand, and *whitneyi* and *amoena* on the other, are frequent in coastal Humboldt and Mendocino counties as indicated above.

Many cultivated strains of *C. amoena* show evidence of having been derived at least in part from subspecies *whitneyi*. This is clearly indicated by the large 8-grooved

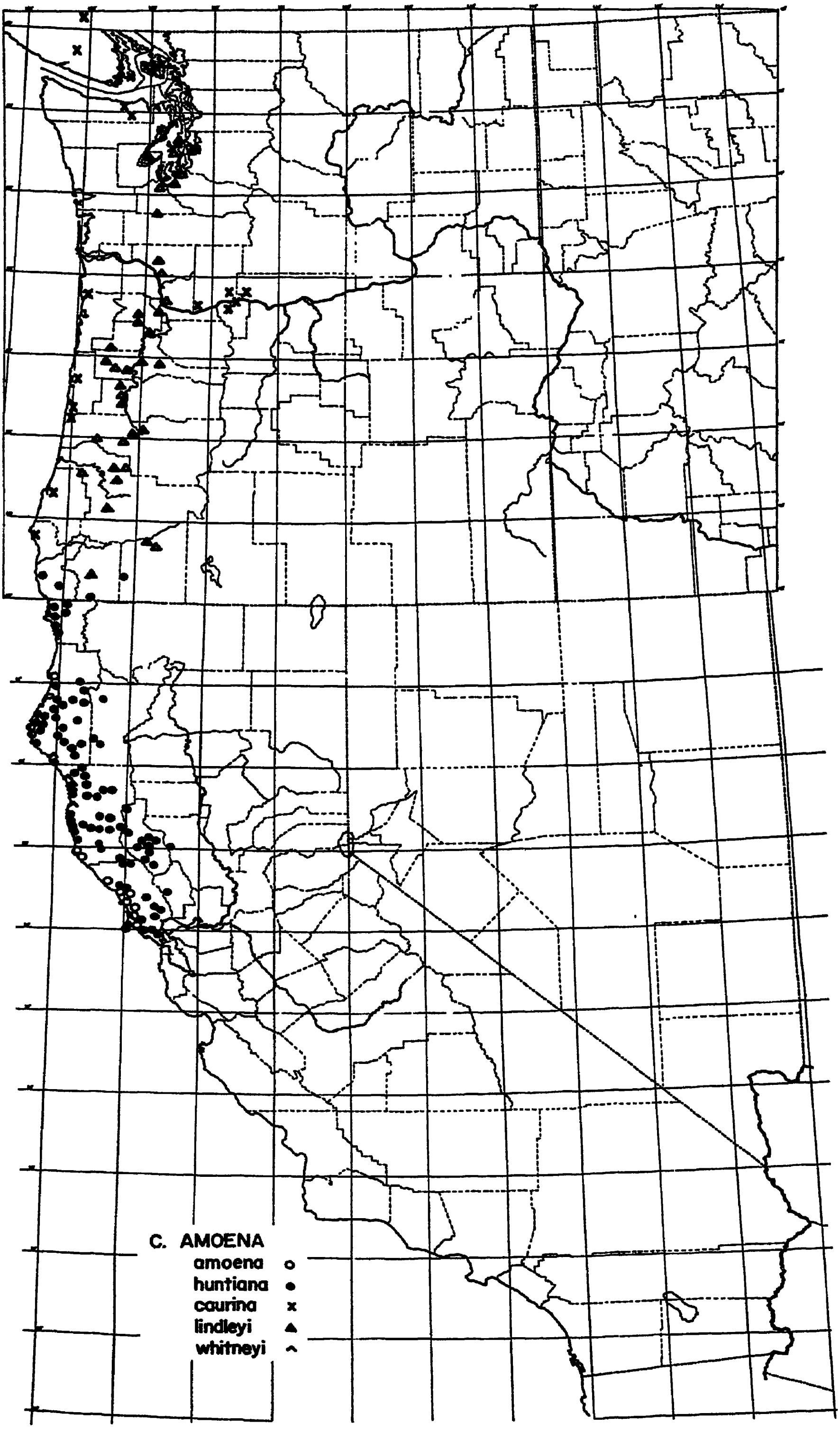


Fig. 2. Distribution of *Clarkia amoena*.

capsules of many of the cultivated varieties. In some areas, these cultivated strains have escaped and have probably contributed to the variation of the natural populations in the same area. We have found a cultivated strain derived from this subspecies growing spontaneously along the coast near Pacific Grove, Monterey County, south of the natural distribution. In this area, it was growing with the closely related species *C. rubicunda*, but there was no evidence of hybridization.

1*d*. **Clarkia amoena** subsp. **lindleyi** (Douglas) Lewis & Lewis comb. nov.

Coarse, erect, strict, as much as 2 m. tall; leaves linear to lanceolate, 3–4 cm. long, 3–4 mm. broad, often congested; inflorescence congested; hypanthium 5–10 mm. long, petals obovate to fan-shaped, 3–4 cm. long, lavender, often streaked with white near the base, the dark-red central spot often absent or represented by a small spot or line; mature style exceeding the stamens; immature capsule 4-grooved, 2–3 cm. long, 2–3 mm. broad, tapering somewhat toward each end but not conspicuously enlarged at the middle, equaling or exceeding the internode above.

Type —Based on the type of *Oenothera lindleyi* Douglas. Northwest coast of America, *Douglas* (Kew).

Oenothera lindleyi Dougl., Bot. Mag. 55: t. 2832. 1828. *Godetia lindleyana* Spach, Hist. Veg. Phan. 4: 392. 1835. *Godetia amoena* var. *lindleyi* Jeps., U.C. Publ. Bot. 2: 329. 1907. *Clarkia amoena* f. *lindleyi* Nels. & Macbr., Bot. Gaz. 65: 62. 1918.

Oenothera macrantha Nutt. *ex* Hook. & Arn, Bot. Beech. Voy. 342. 1840. Part of the type collection examined (N.Y.B.G.). *Godetia macrantha* Lilja, Tradg. Tidning. 1840.

Godetia grandiflora Lindl, Bot. Reg. 27: misc. 61. 1841. No specimen in the Lindley Herbarium that can be taken as the type. Placed in synonomy on the basis of description. *Oenothera grandiflora* Wats., Proc. Am. Acad. 8: 596. 1873. *Clarkia superba* Nels. & Macb, Bot. Gaz. 65: 60. 1918.

Distribution (see fig. 2). –OREGON. Benton, Douglas, Jackson, Josephine, Lane, Marion, Multnomah, Polk, Washington, and Yamhill counties. WASHINGTON. Clark, Cowlitz, King, Kitsap, Mason, Pierce, and Thurston counties. Frequent in the woodland of the interior valleys west of the Cascades. It is now often found growing at the margins of grain fields or railroad rights of way.

Representative specimens.—OREGON. Douglas County: 2–3 miles south of Oakland, *Abrams 8711*. Josephine County: Selma, *Heller 14638*. Lane County: 2 miles southwest of Eugene, *Constance 939*. Marion County: 2 miles south of Salem, *Nelson 801*. Polk County: 5 miles southwest of Dallas, *Peck 16297*. Washington County: north of Gaston, *Thompson 2940*. Yamhill County: Newberg, *Jones 28990*. WASHINGTON. Cowlitz County: 10 miles north of Kelso, *Hitchcock & Martin 4758*. Kitsap County: Port Orchard, *Thompson 9861*. Thurston County: between Olympia and Gate City, *Heller, 4051*.

Progenies from two localities have been studied in the experimental garden: 6 miles north of Eugene, Lane County, Oregon, *866*, and 0.3 mile north of Cove Orchard Post Office, Yamhill County, Oregon, *891*.

We have made no cytological observations. However, Håkansson (1942) examined no fewer than sixteen individuals from a total of six populations of this subspecies. The meiotic configurations were diverse, including a ring of 4 and 5 pairs, two rings of 4 and 3 pairs, a chain of 3, plus an unpaired chromosome and 5 pairs, a ring of 4 plus a chain of 3 plus an unpaired chromosome and 3 pairs, as well as structural homozygotes with 7 pairs. Structural heterozygotes producing the unusual configuration of a chain of 3 and a univalent in this subspecies have received special study by Hiorth (1947*b*, 1948*a*) and Håkansson (1944*b*).

Populations morphologically intermediate between subspecies *lindleyi* and *huntiana* are frequent in southern Oregon and northern California, as indicated above. Intermediates between subspecies *lindleyi* and *caurina* occur in the vicinity of Puget Sound.

Subspecies *lindleyi* has been introduced several times into cultivation and has undoubtedly contributed to modern cultivated varieties.

1*e*. **Clarkia amoena** subsp. **caurina** (Abrams) Lewis & Lewis comb. nov.

Slender, less than 5 dm. tall: leaves 1–3.5 cm. long, 2–5 mm. broad; inflorescence not congested; hypanthium 2–3 mm. long: petals obovate to shield-shaped, usually less than 2 cm. long, lavender, shading to white below, often streaked with white, usually with a bright-red spot at or above the center; mature style not exceeding the stamens, the pollen usually deposited directly upon the stigma of the same flower; immature capsule slender, largest at or just above the middle, about 2 cm. long, 2–3 mm. broad, 4-grooved, the grooves sometimes inconspicuous.

Type.—Based upon the type of *Godetia caurina* Abrams. Olympic Mountains, Clallam County, Washington, *Elmer 2565* (U.S. National Herbarium).

Godetia caurina Abrams *in* Piper, Contrib. U.S. Nat. Herb. 11: 410. 1906. *Clarkia caurina* Nels. and Macbr. Bot. Gaz. 65: 62. 1918.

Godetia pacifica Peck. Proc. Biol. Soc. Wash. 47: 187. 1934. Type: dry open bluff above the sea, Otter Crest, Lincoln County, Oregon, *Peck 16332*, May 23, 1931. Isotypes examined from several herbaria.

Distribution (see fig. 2).—British Columbia. Vancouver Island. Oregon. Coos, Curry, Hood River, Lane, Lincoln, and Tillamook counties. Washington. Clallam, Klickitat, San Juan, and Skamania counties. Along the coast, usually on sea bluffs. Also along the Columbia River.

Representative specimens.—British Columbia. Belmont, *Anderson* in 1894. Vancouver Island: Thetis Lake, *Carter* in 1919; Bald Mountain, Cowichan Lake, *Rosendahl 1849*. Oregon. Lincoln County: Otter Crest, *Peck 16332; Lewis & Lewis 892;* Cape Perpetua, *Peck 18107; Lewis & Lewis 893.* Washington. Mt. Hamilton, *Gorman 4614.* Clallam County: Olympic Mountains, *Elmer 2565;* Eden Valley, Mt. Angeles, *Webster* in 1911; Port Angeles, rocky knob one mile from beach, *Webster 4;* outer end of sand spit, Port Angeles, *Webster* in 1909. San Juan County: south side of St. John's Island, *Lawrence 189;* Friday Harbor, *Zeller 897;* Flat-topped Island, *Peck 12935.*

A number of collections of relatively small-flowered *C. amoena* with capsules that are somewhat enlarged in the upper half have come from the Columbia River. We have not seen this form (cited below) in the field nor have we grown it in the experimental garden. From herbarium material it seems best to refer these collections at least tentatively to subspecies *caurina.*

Oregon. Hood River County: *Suksdorf* in 1896. *Multnomah* County, Rooster Rock, *Suksdorf* in 1895. Washington. Klickitat County: Husum, *Suksdorf* in 1895; Skamania County: Hood, *Suksdorf 10827;* Cape Horn, *Piper 4981; Suksdorf 10529, 10536;* hillsides near Chenowith, *Suksdorf 2129;* Mount Prindle, near Prindle, *Suksdorf 11741;* Doaf Creek near Cook, *Suksdorf 11488.*

Progenies from two localities in Oregon have been studied in the experimental garden: Otter Crest, *892,* and Cape Perpetua, *893.*

Although the plants grown under cultivation were much larger than any observed in the wild, the flowers remained small and were self-pollinating. We have made no cytological observations on this material. However, Håkansson (1942) examined microsporocytes of at least four plants from a total of three populations (Saanich, Sooke, and Otter Crest). All of these were structural homozygotes with seven pairs of chromosomes, although interpopulational hybrids between Saanich and Otter Crest formed a ring of four. Hybrids between subspecies *caurina* and subspecies *lindleyi, amoena,* and *huntiana* were found to be fertile (Hiorth, 1942*a*), although these hybrids were heterozygous for a variety of translocations (Håkansson, 1942).

Intermediates between subspecies *caurina* and subspecies *lindleyi* occur in the vicinity of Puget Sound. One collection from Vancouver Island (*Edwards* in 1873) has petals 2.5 cm. long

This small-flowered race has not contributed to the cultivated varieties.

Relationship.—*Clarkia amoena* occupies the greatest area of any diploid species in the genus and at the same time is the most diverse with respect to morphology, ecology, and chromosome rearrangements. This suggests that it may be one of the oldest, if not the oldest, species in the genus.

The species most closely related to *C. amoena* is *C. rubicunda*, which is not always readily distinguishable from it. On morphological grounds, as well as geographical distribution, one might well consider *C. rubicunda* to be a geographical race or subspecies of *C. amoena.* However, Rasmuson (1921), Chittenden (1928), and Hiorth (1942*a*) have each shown that hybrids between the two taxa are consistently sterile or nearly so. Håkansson (1942, 1947) and Chittenden (1928) found meiosis to be irregular (see Appendix II for the names used by these authors). The areas of distribution of *C. amoena* and *C. rubicunda* overlap in Marin County, California, but we have not observed them growing together. They can be most readily distinguished morphologically by the color pattern of the flowers. *Clarkia rubicunda* is characterized by petals with a bright-red base and bright-red anthers, although one can find sporadic variants without the basal spot on the petal. *Clarkia amoena*, on the other hand, usually has a bright-red spot in the center of the petal and the anthers are lavender to yellowish or white but not red.

Clarkia amoena is one of the parents of the alloploid species *C. gracilis* (Håkansson, 1942), and the two are frequently difficult to distinguish, particularly from herbarium material. Living plants, however, are readily distinguished by the drooping buds and leader of *C. gracilis* and the erect stems and buds of *C. amoena.* But this difference is no longer evident at the end of flowering. In older material, the capsule, particularly when immature, is usually definitive. It is usually enlarged above the middle in *C. gracilis* but generally not in *C. amoena.* Furthermore, the capsules of *C. amoena* usually open as soon as they have dried, whereas those of *C. gracilis* are greatly retarded in opening and may not shed their seeds until weeks or even several months after they have matured.

2. **Clarkia rubicunda** (Lindley) Lewis & Lewis, Madroño. 12: 34. 1953.
(Fig. 3, *d, e.*)

Erect to prostrate, as much as 1.5 m. tall; stems simple or branched, puberulent above with short, upwardly curled or spreading hairs, sparsely puberulent or glabrate below; leaf blades narrowly to broadly lanceolate or elliptic, entire to denticulate, 1–4 cm. long, 2–18 mm. broad, sparsely puberulent to glabrate, narrowed to petioles as much as 1 cm. long; rachis of inflorescence erect; buds erect; hypanthium 4–10 mm. long, not conspicuously colored within, the ring of hairs at the middle or within the central third; sepals lanceolate, 12–28 mm. long, 2.5–7 mm. broad, remaining united and deflexed to one side at anthesis, occasionally completely reflexed; petals obovate to fan-shaped, subentire to erose, sometimes emarginate, 1–3 cm. long, scarcely clawed, rosy-pink to lavender with a conspicuous, bright-red or reddish-purple base, the basal spot rarely inconspicuous or wanting; stamens 8; anthers red, becoming purple after dehiscence; filaments red; pollen yellow; stigma 4-lobed, the lobes linear, white; style pink or red, exceeding the stamens at maturity; ovary slender, 1.5–3 cm. long, 4-grooved, densely puberulent with short upwardly curled or spreading hairs, sessile or on a pedicel as much as 4 cm. long; mature capsule blunt, sometimes with a short beak, terete or nearly so, 2–4 cm. long, 2.5–3 mm. broad; seeds brown or grayish, scaly, 1.2–1.5 mm. long, the crest less than 0.2 mm. long.

Type.—Based upon the type of *Godetia rubicunda* Lindley. Northwestern America, *Douglas* in 1830 (Lindley Herbarium).

Clarkia rubicunda is similar to *C. amoena* with respect to ecological and morphological variation, although on a smaller scale, commensurate with its more restricted area of distribution. Two geographical expressions of *C. rubicunda* have been designated as subspecies. They bear a relationship to each other similar to that of *C. amoena amoena* and *C. amoena huntiana* in that one is coastal and the other is interior. These subspecies of *C. rubicunda* are interfertile (Hiorth, 1942*a*), and no structural differences in their chromosomes are apparent at meiosis in their hybrids (e.g., Sunol × San Gregorio, Håkansson, 1942).

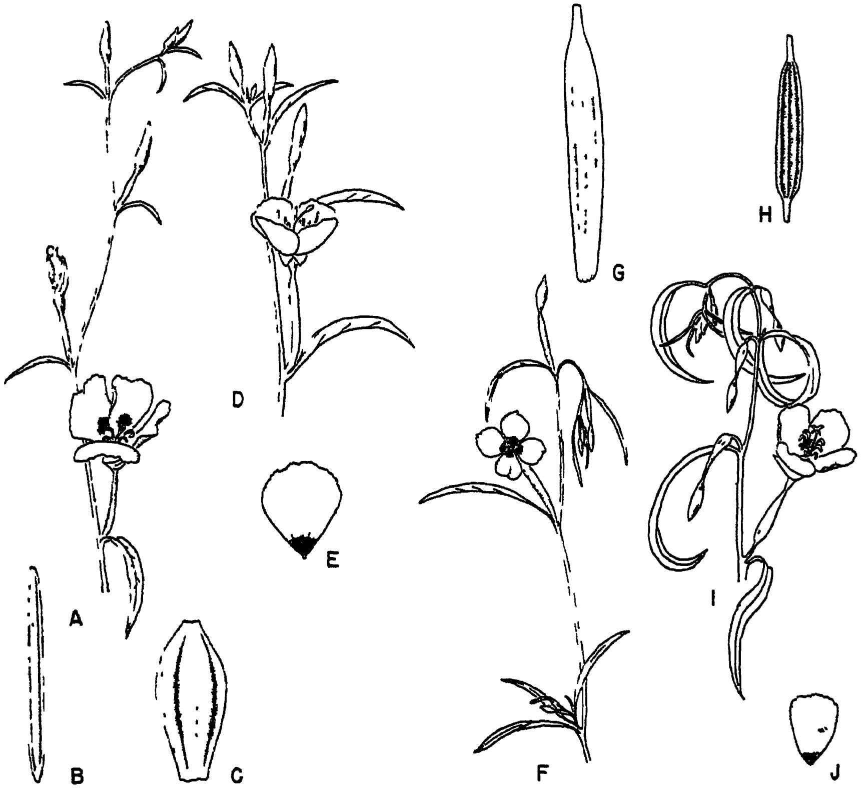


Fig. 3. *a, Clarkia amoena* subsp. *huntiana*, inflorescence × ½; *b*, capsule × 1; *c*, *C. amoena* subsp. *whitneyi*, capsule × 1; *d*, *C. rubicunda* subsp. *rubicunda*, inflorescence × ½; *e*, petal × ½; *f*, *C. lassenensis*, inflorescence × ½; *g*, capsule × 1; *h*, *C. arcuata*, capsule × 1; *i*, inflorescence × ½; *j*, petal × ½.

KEY TO THE SUBSPECIES

Stems slender; inflorescence lax; internodes longer than the subtending ovary 2*a*. subsp. *rubicunda*

Stems coarse; inflorescence crowded; internodes shorter than the subtending ovary 2*b*. subsp. *blasdalei*

2*a*. Clarkia rubicunda subsp. rubicunda. (Fig. 3, *d*, *e*.)

Slender, erect or somewhat decumbent; leaves narrowly lanceolate to lanceolate, acute, 1–4 cm. long, 2–10 mm. broad; inflorescence lax, the internodes longer than the subtending ovary; sepals 12–20 mm. long, 2.5–4 mm. broad; petals mostly 1–2.5 cm. long, lavender with a bright-red basal spot, the spot sometimes absent.

Godetia rubicunda Lindl., Bot. Reg. 11: t. 1856. 1836. *Oenothera rubicunda* Hook. & Arn., Bot. Beech Voy. 342. 1840.

Distribution (see fig. 4).—CALIFORNIA. Alameda, Marin, Monterey, Santa Clara, Santa Cruz, San Francisco, and San Mateo counties. Usually in openings in the woodland and coastal forest, sometimes along the coast.

Representative specimens.—CALIFORNIA. Alameda County: Niles Canyon, 3 miles west of Sunol, *Hitchcock 17.* Marin County: Highway 1 at junction of road to Stinson Beach, *Lewis & Lewis 441.* Monterey County: Highway 1, 4.1 miles north of San Luis Obispo County line, *Lewis & Lewis 715.* San Mateo County: Crystal Springs Lake, *Elmer 4310.* Santa Clara County: foothills west of Los Gatos, *Heller 7479.* Santa Cruz County: Watsonville, *Elmer 5053;* Highway 9, 1.8 miles west of junction with Highway 5, *Lewis & Lewis 505.*

Progenies from the following localities have been studied in the experimental garden. Santa Cruz County: Highway 9, 4.3 and 1.8 miles west of junction with Highway 5, *504* and *505.*

The haploid chromosome number is 7. We have examined root-tip chromosomes of only one individual from the Santa Cruz Mountains, *505*. However, more extensive observations on microsporocytes were made by Håkansson (1941*b*, 1942, as *G. amoena*). No meiotic irregularities were observed even in interpopulational hybrids.

Intermediates between *C. rubicunda rubicunda* and *C. rubicunda blasdalei* are frequent in the areas where their distributions overlap.

2*b*. **Clarkia rubicunda** subsp. **blasdalei** (Jepson) Lewis & Lewis comb. nov.

Stems coarse, erect to prostrate; leaves thickish, elliptic to broadly lanceolate, the largest 2–3 (5) cm. long, 10–18 mm. broad, acute or obtuse; inflorescence crowded, the internodes shorter than the subtending ovary; sepals 15–28 mm. long, 4–7 mm. broad: petals 2.5–3.0 cm. long, usually pale lavender with a red spot at the base.

Type.—Based on the type of *Godetia blasdalei* Jepson. Point Isabel, Contra Costa County, California. *W. C. Blasdale,* July 11, 1893 (U.C. Berkeley).

Godetia blasdalei Jeps., U.C. Publ. Bot. 2: 330. 1907.

Distribution (see fig. 4).—CALIFORNIA. Alameda, Contra Costa, San Francisco, San Mateo, Santa Cruz, Marin, Monterey, and northern San Luis Obispo counties. Along the immediate coast. It is particularly common in San Mateo County.

Representative specimens.—CALIFORNIA. Contra Costa County: Point Isabel, *Brandegee* in 1908. Marin County: Tiburon, *Heller 5726.* Monterey County: Highway 1, 9.8 miles north of Pfeifer Gulch Bridge, *Lewis & Lewis 718.* San Luis Obispo County: San Carpoforo Creek and Arroyo de la Cruz, *Hoover 7387.* San Mateo County: Pigeon Point, *Eastwood & Howell 6067; Wiggins 8933;* Moss Beach, *Brandegee* in 1905; 1.8 miles south of Sharp Park, *Lewis & Lewis 859;* near Half Moon Bay, *Lewis & Lewis 861.* Santa Cruz County: Santa Cruz, *Jones* in 1901.

We have grown no progenies of this subspecies in the experimental garden. However, Hiorth (1942*a*) has grown populations from Montara Point and San Gregorio, and they retained their characteristic traits under cultivation.

The haploid chromosome number is 7 (Håkansson, 1941*b*, 1942, as *G. amoena*). No meiotic irregularities have been observed.

Depauperate plants with a single small flower are found in all species of *Clarkia* but are seldom as extreme as in *C. rubicunda*. Plants 1 cm. tall may be found with petals barely 4 mm. long (e.g., San Francisco, cliffs between Bakers Beach and Lands End, *Brandegee* in 1907; Rockaway Beach, San Mateo County, *Lewis & Lewis 860*). White-flowered plants may be found sporadically (Los Gatos, *Cannon* in 1892).

Several interesting collections have come from the Presidio, San Francisco (*Brandegee* in 1905, 1907, and 1908; *Eastwood 257*, and *Raven 813*). They are unique in their small (10–15 mm. long) wedge-shaped petals that are abruptly truncate and erose at the summit. The stems, leaves, and capsules are all very slender. They are ap-

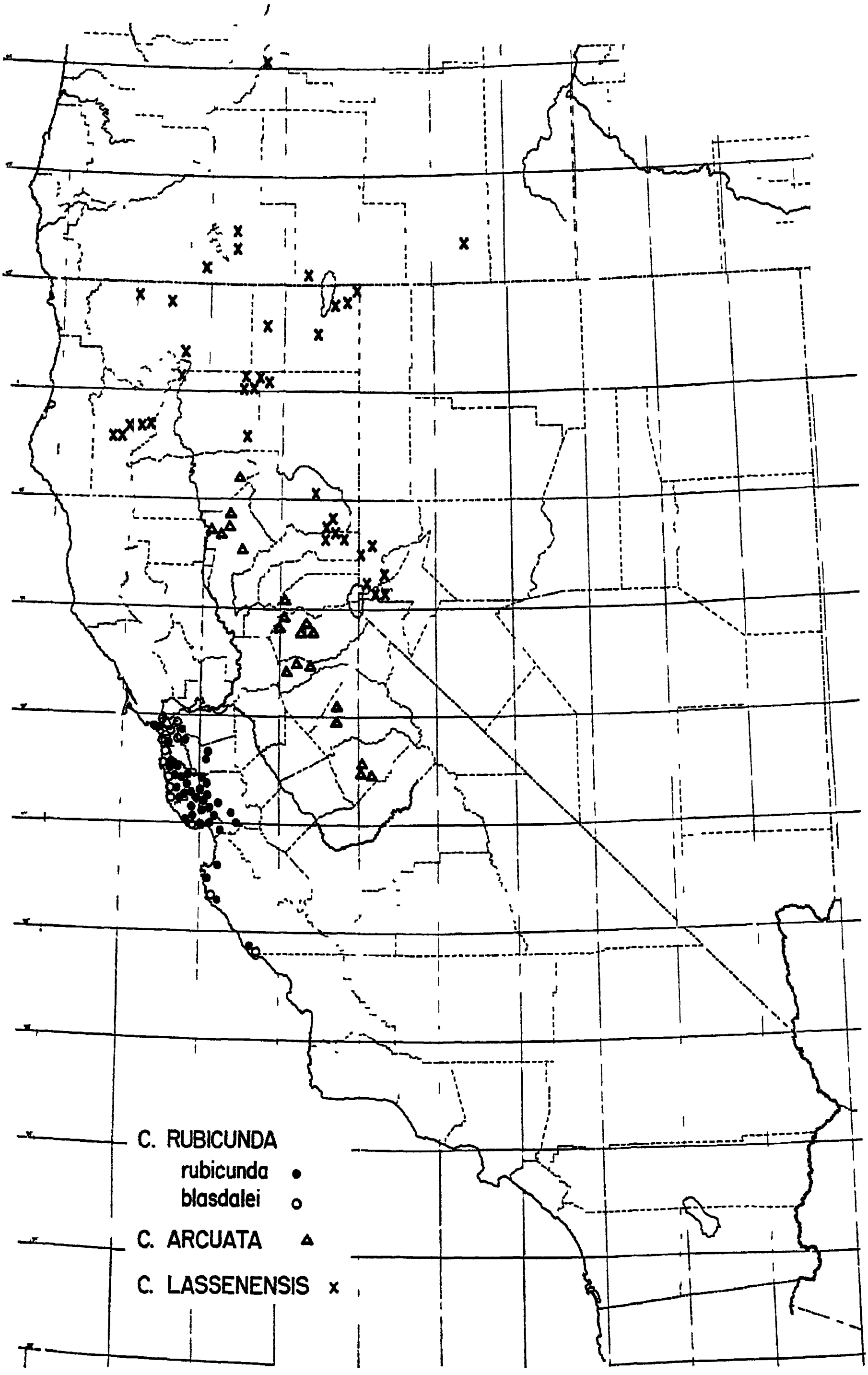


Fig. 4. Distribution of *Clarkia rubicunda*, *C. arcuata*, and *C. lassenensis*.

parently closely related to *C. rubicunda*, but at the same time they probably warrant formal taxonomic recognition. We are deferring such recognition, however, until we have had an opportunity to examine living material.

Relationship.—Clarkia rubicunda is very closely related to *C. amoena*, and they are frequently difficult to distinguish as herbarium specimens. As living plants, however, they are usually readily distinguished by the color pattern of the petals; the former characteristically has a red basal spot on the petals, whereas the latter never has a red spot at the base but usually has a red spot in the center of the petals. However, variants with no spots occur in each. Hiorth (1942*a*) indicates that the two taxa differ with respect to the capsule, particularly with respect to the time of dehiscence after ripening. These presumed differences have not been at all consistent in our cultures. The morphological differences separating these two taxa are not nearly so great as the differences within each. Furthermore, they replace each geographically, although their two ranges overlap or at least approach each other in southern Marin County, California. However, we have no record of them growing together. The morphological and geographical relationships of *C. rubicunda* and *C. amoena* suggest that they might best be considered as subspecies of one large polytypic species. On the basis of extensive studies, however, it seems best to recognize two species. These two taxa have been extensively hybridized by several investigators and the hybrids without exception have been nearly sterile, although a few individuals can be produced by backcrossing (Hiorth, 1942*a*). Meiosis in the hybrids indicates that the genomes differ by several rearrangements (Håkansson, 1942, 1947).

Clarkia rubicunda has been crossed to *C. gracilis*, and from the variability in pairing observed at meiosis it was concluded by Håkansson (1943*a*) that *C. rubicunda* was not directly related to *C. gracilis*.

SUBSECTION FLEXICAULES SUBSEC. NOV.

Inflorescentium axe in apice recurvato: ovario 8-costato vel 8-canaliculato.

Rachis of the inflorescence recurved, becoming erect as the flowers open; buds pendulous; ovary and immature capsules 8-grooved or strongly 8-ribbed.

Type species.—C. arcuata (Kellogg) Nelson and Macbride.

3. **Clarkia arcuata** (Kellogg) Nelson and Macbride, Bot. Gaz. 65: 62. 1918.
(Fig. 3, *h*, *i*, *j*.)

Erect, as much as 7.5 dm tall; stems simple or branched above, occasionally at the base, glabrous or puberulent with scattered, straight spreading hairs; leaf blades linear to narrowly lanceolate or oblanceolate, entire or nearly so, 1.5–6 cm long, 1–5 mm broad, sessile; rachis of the inflorescence reflexed, becoming erect as the flowers open; buds pendulous; hypanthium 3–7 mm. long, puberulent with straight spreading hairs and shorter glandular hairs, dark red-purple within, the ring of hairs near the middle, with or without a swelling at the summit of the ovary; sepals green or tinged with red, lanceolate, puberulent with short glandular hairs and longer eglandular spreading hairs, 1–2.5 cm. long, 3–5 mm. broad, remaining united and deflexed to one side at anthesis; petals 1-3 cm. long, fan-shaped, rounded to truncate, sometimes emarginate, pinkish-lavender, somewhat lighter below, frequently with a dark-reddish spot at the base, sometimes with a large red spot on the back side; anthers dark purple; pollen yellow; filaments lavender to dark reddish-purple; stigma 4-lobed, the lobes linear, 1–5 mm. long, cream to yellow; style red, exceeding the stamens at maturity; ovary 8-ribbed, 1–3 cm. long, becoming green and shining, sparsely puberulent with straight spreading or upwardly curled and usually glandular hairs; capsule delayed in opening, terete or somewhat quadrangular, 0.7–3.5 cm. long, 1.5–2.5 mm. broad, sometimes slightly enlarged in upper half, the beak as much as 7 mm. long, pedicelate on a stout pedicel 5–15 mm. long; seeds brown, 2

mm. long, minutely scaly on the dorsal side, conspicuously crested, the crest about 0.5 mm. long.
Type.—Based on *Oenothera arcuata* Kellogg.

The specific name *arcuata* for this distinctive species was rejected by Hitchcock 1930) inasmuch as the type specimen of Kellogg's *Oenothera arcuata* collected by Garvett could not be found (presumably destroyed in the San Francisco earthquake and fire of 1906). Hitchcock was of the opinion that the original description could fit *C. amoena* as well as the present species and, therefore, adopted the name *Godetia hispidula* Wats. Hitchcock's concept of the species *amoena*, however, was much too inclusive. With our present knowledge of the species in this section, and their distribution, there seems to be no doubt as to the species described by Kellogg. The stigma is described as yellow and the style red, a striking characteristic of the present species and one which would exclude all of the sections of *Clarkia* except Primigenia. *Oenothera arcuata* is further described as having recurved-nodding stems which would certainly eliminate *C. amoena* and *C. rubicunda* from further consideration. This leaves as possibilities *C. lassenensis*, *C. gracilis*, and the present species. Kellogg's description refers to the ovary as cylindric, 8-grooved, and attenuate at each end. The ovary of *C. gracilis* is 4-grooved and the ovary of *C. lassenensis* is certainly not attenuate at each end. The flowers are described as large, which is hardly descriptive of the flowers of *C. lassenensis* or *C. gracilis gracilis*. Furthermore, the apparent type locality of *Oe. arcuata* would eliminate all of the above species in Primigenia. No locality is given for the Garvett specimen in the original account, but on a sheet of the present species collected by Mrs. Brandegee on May 25, 1907, is written, "near Placerville (type locality of E. W. Garvett)." It is not improbable that she was familiar with the type specimen and may well have had specific information concerning its place of origin. Jepson (1907) also gives Placerville as the type locality. Therefore, since the original description of *Oe. arcuata* excludes all other species known to us (except the later synonyms *Oe. hispidula* Wats. and *G. hanseni* Jeps.), and the presumed type locality is within keeping with this interpretation, we can see no alternative to adopting *C. arcuata* as the valid name for this species. The specimen of K. Brandegee, May 25, 1907, near Placerville (Cal. Acad.) can be taken as a neotype.

Oenothera arcuata Kellogg, Proc. Cal. Acad. 1: 58 (2d ed.) 1855. *Godetia arcuata* Jeps. U.C. Publ. Bot. 2: 335. 1907.

Oenothera hispidula Wats., Proc. Amer. Acad. 8: 599. 1873. Type: Sacramento Valley, *Fremont* in 1846 (Gray Herbarium). *Godetia hispidula* Wats., Bot. Calif. 1: 231. 1876.

Godetia hanseni Jeps., U C. Publ. Bot. 2: 336. 1907. Type: Armstrong's Station, Amador County, California, *Hansen 1090* in 1895 (Kew).

Distribution (see fig. 4).—CALIFORNIA. Amador, Butte, Calaveras, Eldorado, Mariposa, Placer, Tehama, and Tuolumne counties. Foothills of the Sierra Nevada, usually on grassy openings in the woodland or chaparral, often on thin soils that dry early in the season and sometimes on serpentine.

Specimens examined.—CALIFORNIA. Without County: Sacramento Valley, *Fremont* in 1846. Amador County: near Wylies Station, *Brandegee* in 1910; Hams, *Hansen 1090, 1323;* Panther Creek, *Hansen 1090;* Vorhees School near Dry Creek, *Mason 6997;* 1.25 miles northwest of Sugarloaf, *Nordstrom 764.* Butte County: Chico, *Austin* in 1883; *Gray* in 1885; Little Chico Creek, *Austin 124* and in 1896; Little Chico, *Austin 1956;* Rancho Chico, *Bidwell* in 1885 and 1878; Durham, *Morrison* in 1932; mountains near Durham, *Brown* in 1935; foothills near Chico, *Bruce 1956* and in 1897; Salmon Hole, east of Chico on Chico Creek, *Heller 15041a;* Table Mountain near Oroville, *Heller 16475;* Nimshew to Butte Creek Canyon, 1 mile below Nimshew, *Lewis & Lewis 825;* Nimshew to Butte Creek Canyon, 1.6 miles below Nimshew; *Lewis & Lewis 826;* near Nimshew, *Van Eseltine*

1724; Calaveras County: near Harmon Peak, *Davy 1407*. Eldorado County: near Placerville, *Brandegee* in 1907; Sportsmans Hall, 12 miles above Placerville, *Brandegee* in 1907: Simpson Ranch, Sweetwater Creek, *Brandegee* in 1908: between Cool and Auburn, *Brandegee* in 1908: Armstrong's Station, *Hansen 1090;* Plum Creek, *Johannsen & Gifford 346;* Park Creek Road, west of its junction with Plum Creek and Hazel Valley Roads, *Robbins 1168;* North Fork of Webber Creek about 3 miles east of Camino, *Robbins 1612*. Mariposa County: Mormon Bar, *Congdon* in 1892; Lewis, *Condon* in 1895; west side of Mariposa Valley, *Congdon* in 1897; Sherlocks, *Condon* in 1898; 3.4 miles north of Merced River Bridge at Bagby, *Lewis & Lewis 349;* 3.5 miles north of Merced River Bridge at Bagby, *Lewis & Lewis 350*. Placer County: 6 miles north of Colfax, *Hitchcock 6410*. Tehama County: between Mineral and Popes Creek, *Gillespie 9395*. Tuolumne County: top of ridge above Twain Harte P.O., *Alexander & Kellogg 3617;* between Confidence and Tuolumne, *Wieslander 76*.

Progenies from the following localities have been studied in the experimental garden. Butte County: Nimshew to Butte Creek Canyon, 1 mile below Nimshew, *825*. Mariposa County: 3.4 and 3.5 miles north of the bridge at Bagby, *349* and *350*.

The haploid chromosome number is 7 (Håkansson, 1941*b*, as *G. hispidula*). We have examined microsporocytes of one plant from each of localities *350* and *825*. The material examined by Håkansson came from Placerville, Eldorado County. No meiotic irregularities have been found.

Clarkia arcuata shows considerable intraspecific variation with respect to flower and plant size, petal markings, pubescence, and conformation of the capsule. When a progeny from Mariposa County was grown with a progeny from Butte County under uniform garden conditions, the former were larger and had larger flowers. In addition to size, they differed conspicuously in petal color pattern. The southern plants had a large red blotch on the back of the petal which was totally absent in the northern material. Unfortunately, such differences disappear rapidly in herbarium material so that it is not possible without additional field work to determine the nature of the geographical differentiation within this species. Our field observations have been limited to two areas at the extremes of the distribution range. The species is rather infrequent, although locally abundant, and is one of the earliest to flower. Consequently, it has usually been past flower and hence difficult to locate at the times we have been in its area. The variation in pubescence and conformation of the capsule does not seem to follow any consistent geographical pattern.

Relationship.—*Clarkia arcuata* is morphologically most closely related to *C. lassenensis*. They differ conspicuously, however, in several ways. The former normally has much larger flowers designed to promote outcrossing, whereas the small flowers of the latter are primarily self-pollinated. The capsules of the two species differ conspicuously in conformation, and those of *C. lassenensis* are much more massive. The two species replace each other geographically and are not known to grow together. Seeds have been obtained from crosses between them, but the hybrid plants died before reaching maturity, consequently their cytological relationship is not known. *Clarkia arcuata* differs morphologically from species in Subsection Primgenia in several ways, perhaps most notably in the strongly 8-ribbed capsules and drooping leader. Sterile hybrids between *C. arcuata* and *C. rubicunda* were obtained by us, and a sterile hybrid between *C. arcuata* and *C. amoena* was obtained by Hiorth (*ex* Håkansson, 1946*b*), but meiosis could not be studied in either hybrid. It was suggested by Hiorth (1941) that *C. arcuata* might be one of the parents of the alloploid species *C. gracilis*. However, the cross between these two species was subsequently made and examined cytologically by Håkansson (1946*b*). The very low degree of pairing found in these hybrids indicates that *C. arcuata* and *C. gracilis* are not immediately related.

4. **Clarkia lassenensis** (Eastwood) Lewis & Lewis, Madroño 12: 33. 1953. (Fig. 3, *f*, *g*.)

Erect, as much as 9 dm. tall; stems usually simple, sometimes branched above, puberulent above with spreading or ascending hairs, sparsely puberulent or glabrate below; leaf blades linear to narrowly lanceolate, entire or nearly so, 2–5 cm. long, 2–5 mm. broad, puberulent on both surfaces, narrowed to petioles as much as 1 cm. long; the rachis of the inflorescence recurved in bud, becoming erect as the flowers open; buds pendulous; hypanthium 3–5 mm. long, not conspicuously colored within, sometimes striped with dark red, the ring of hairs below the middle; sepals lanceolate, 7–14 mm. long, 2–2.5 mm. broad, remaining united and deflexed to one side at anthesis; petals 8–16 mm. long, pinkish-lavender shading lighter toward the base, the base bright reddish-purple; stigma white, 4-lobed, the lobes linear, ascending; style lavender below, white above, shorter than the stamens; ovary densely puberulent with short, upwardly curled hairs, appearing striate, 10–25 mm. long, sessile or on a pedicel as much as 3 mm. long; immature capsule conspicuously 8-ribbed, at maturity often slightly enlarged above, subterete, 2.5–4 cm. long, 3–3.5 mm. broad, abruptly narrowed into a beak 2 mm. long; seeds light brown or spotted, minutely tuberculate, 1.5 mm. long, the crest about 0.2 mm. long.

Type.—Based on the type of *Godetia lassenensis* Eastwood. Big Valley Mountains between Fall River Mills and Nubieber, Lassen County, California, *Eastwood & Howell 7983* (Cal. Acad.).

Godetia lassenensis Eastw., Leafl. West. Bot. 2: 281. 1940.

Distribution (see fig. 4).—CALIFORNIA. Lassen, Modoc, Plumas, Shasta, Sierra, Siskiyou, and Trinity counties. NEVADA. Ormsby, Storey, and Washoe counties. OREGON. Deschutes, Harney, Klamath, and Lake counties. Usually found in open sites in the woodland or adjacent coniferous forest.

Representative specimens.—CALIFORNIA. Lassen County: 12 miles north of Fall River Mills, *Hitchcock 6610*. Modoc County: Fandango Pass, *Howell 12069;* Parker Creek, Warner Mountains, *Howell 11942*. Plumas County: Highway 89, north of junction with Highway 24 near Feather River, *Heller 16503*. Shasta County: 2 miles west of Fall River Mills below Pit River Dam, *Hitchcock 6596;* Hat Creek about 20 miles from Fall River Mills, *Hitchcock 6529*. Trinity County: Saddle between North Yolla Bolly and Black Rock Mountains, Yolla Bolly–Middle Eel Primitive Area, *Alexander & Kellogg 5727;* Hayfork–Douglas City Road, 0.4 mile south of Trinity National Forest boundary, *Lewis & Lewis 408*. NEVADA. Ormsby County: Carson City, *Jones* in 1897; Ash Canyon, *Baker 980*.

We have had an opportunity to study natural populations of this species in the field at three localities in Trinity County. Progenies from one of these populations have been studied in the experimental garden (U.S. Highway 299, 6.6 miles west of Trinity-Shasta County line, *404*). Five individuals have been examined cytologically. Three of these had microsporocytes with 7 pairs of chromosomes and no irregularities. Root tips of two other plants had, respectively, one and two small fragment chromosomes in addition to the normal complement.

The material we have grown has been very uniform. This uniformity, together with the short style, position of the stamens, and stigma that never fully opens, indicates that it is normally self-pollinated.

Relationship.—*Clarkia lassenensis* has usually been confused with *C. purpurea* or *C. gracilis* in herbarium material. However, the similarity of *C. lassenensis* to *C. purpurea* (Section Godetia) is certainly superficial. As living plants, particularly where the two are found growing together, they are easily distinguished by many differences such as the color and conformation of the corolla, the differences in capsule, and most conspicuously by the erect buds and rachis of the inflorescence of *C.*

purpurea as opposed to the reflexed rachis of *C. lassenensis*. These differences are, however, frequently obscured in pressed material. The differences between *C. lassenensis* and the allotetraploid *C. gracilis* are less conspicuous. This is not unexpected inasmuch as both morphological and cytological evidence indicates that *C. lassenensis* is one of the parents of the latter (see *C. gracilis*). *Clarkia lassenensis* would hardly be confused with the two large-flowered subspecies of *C. gracilis* and differs from the small-flowered *C. gracilis gracilis* in having a basal spot of color on the petal rather than uniformly colored petals. Furthermore, it differs from all of the subspecies of *C. gracilis* in having 8-ribbed rather than 4-grooved capsules. The two species may also differ in flowering time. We have observed *C. lassenensis* and *C. gracilis gracilis* growing together in Trinity County in the middle of June. At that time the latter had mature capsules, whereas the former had scarcely begun to flower. *Clarkia lassenensis* is also closely related to *C. arcuata*. These two species replace each other geographically and are not sympatric. They are readily distinguished by the smaller flowers and short styles of the former as well as conspicuous capsule differences.

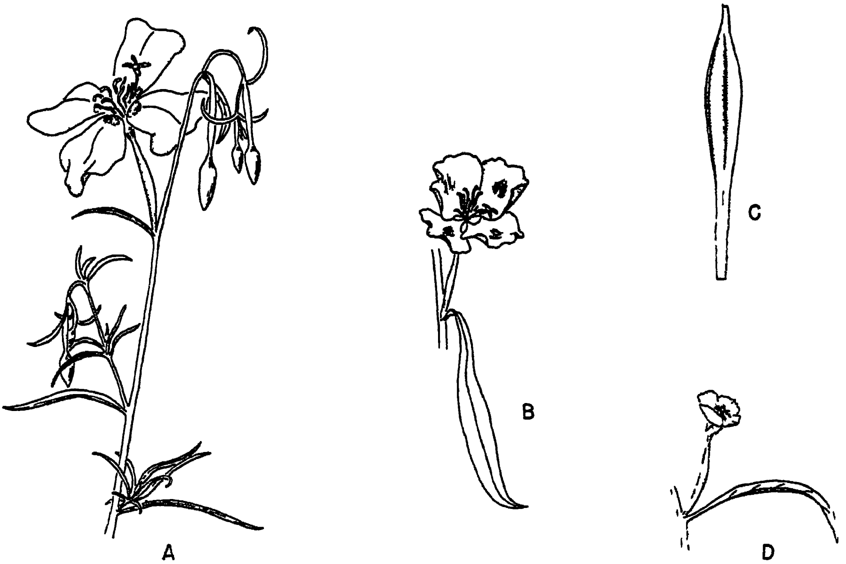


Fig. 5. *a*, *Clarkia gracilis* subsp. *albicaulis*, inflorescence × ½; *b*, *C. gracilis* subsp. *sonomensis*, flower × ½; *c*, *C. gracilis*, capsule × 1; *d*, *C. gracilis* subsp. *gracilis*, flower × ½.

SUBSECTION JUGALES SUBSEC. NOV.

Inflorescentium axe in apice recurvato; ovario 4-canaliculato.

Rachis of the inflorescence recurved, becoming erect as the flowers open; buds pendulous; ovary and immature capsules 4-grooved.

Type species.—*C. gracilis* (Piper) Nels. & Macbr.

5. **C. gracilis** (Piper) Nelson and Macbride, Bot. Gaz. 65: 63. 1918. (Fig. 5.)

Erect, as much as 9 dm. tall; stems simple or branched, glabrate to silvery pubescent above with upwardly appressed or spreading hairs, glabrous to sparsely puberulent below; leaf blades linear to narrowly lanceolate, entire or nearly so, 2–7 cm. long, 2–6 mm. broad, glabrate to sparsely puberulent, narrowed to petioles as much as 1 cm. long; rachis of the inflorescence recurved in bud, becoming erect as the flowers open; buds pendulous; hypanthium 1.5–10 mm. long, usually red to dark reddish-purple within, the ring of hairs near the middle or below or above, sometimes absent; sepals lanceolate, 8–30 mm. long, 1–5 mm. broad, remaining united and deflexed to one side at anthesis; petals obovate to fan-shaped, entire to erose at the summit, sometimes apiculate or emarginate, 8–40 mm. long, pinkish-lavender, often lighter below, unspotted or with a brilliant-red central or basal spot; stamens 8; anthers usually yellow; the tips acute or mucronate; pollen yellow; stigma 4-lobed; style at maturity shorter than, equal to or exceeding the stamens; ovary 4-grooved, puberulent, 10–40 mm. long, sessile or on a pedicel as much as 1 cm. long; mature capsule terete, conspicuously tapered upward, largest above the middle, 2.5–5 cm. long, 2–5 mm. broad at the broadest point, attenuate into a slender beak as much as 1 cm. long; seeds brown, often mottled, scaly, 1.5–2 mm. long, the crest as much as 0.2 mm. long.

Type.—Based on *Godetia gracilis* Piper. Silverton, Oregon, *Elihu Hall 192* in 1871 (isotypes from several herbaria examined).

Clarkia gracilis is a polytypic allotetraploid species found in the oak woodland or at the lower margin of the montane forest of northern California and Oregon. Three principal morphological expressions have been designated as subspecies.

The intraspecific relationships in *C. gracilis* have been examined extensively by Hiorth (1942*a*). He divided this species into five races under the name *G. nutans* (not validly published). His southern Oregon race belongs to *C. gracilis gracilis*, a subspecies which is even more common in northern California than it is in Oregon. His Sonoma and Canyonville (large-flowered) races can be assigned to subspecies *sonomensis*, and his Magalia race belongs to subspecies *albicaulis*. The race from Buck Mountain which we have also grown is morphologically intermediate between subspecies *gracilis* and *sonomensis*, as discussed below. Hiorth (1942*a*) found that one of the intraspecific crosses was quite sterile (subspecies *sonomensis* from Canyonville × subspecies *gracilis* from Wonder). Both of the populations involved, however, formed fertile hybrids when crossed to subspecies *albicaulis* from Magalia.

KEY TO THE SUBSPECIES

A. Petals less than 2 cm. long, unspotted; mature style shorter than the stamens 5*a*. subsp. *gracilis*

AA. Petals more than 2 cm. long, with a red spot at the center or base; mature style longer than the stamens.

- B. Petals with a central spot; plants of the North Coast Ranges of California and southern Oregon.. .. .. 5*c*. subsp. *sonomensis*
- BB. Petals with a basal spot; plants of interior northern California....... 5*b*. subsp. *albicaulis*

5*a*. **Clarkia gracilis** subsp. **gracilis**. (Fig. 5, *d*.)

Hypathium 1.5–3 mm. long, usually red to purple within, at least in the upper part, the ring of hairs present or absent; sepals lanceolate, 8–9 (12) mm. long, 1–2.5 mm. broad; petals obovate to fan-shaped, entire to erose or apiculate, 6–20 (23) mm. long, pink to lavender, sometimes darker near the base,, rarely with a red central spot; stamens adhering closely to the stigma; anthers cream; pollen yellow; filaments lavender; stigma cream, with 4 short lobes; style at maturity shorter than the stamens; ovary 10–35 mm. long, sessile or on a pedicel as much as 5 mm. long; immature capsule conspicuously 4-grooved, usually notably enlarged above the middle; mature capsule 3–5 cm. long, 2–3 mm. broad at the broadest point, not always noticeably enlarged above, attenuate to a slender beak as much as 1 cm. long.

Godetia gracilis Piper *in* Piper & Beattie, Fl. N.W. Coast 251. 1915. *Godetia amoena* var. *gracilis* Hitch., Bot. Gaz. 89: 342. 1930.

Godetia amoena var. *concolor* Jeps., Fl. W. Mid. Cal. 334. 1901. Type: Pope Valley Grade from Calistoga, *Jepson*, May 2, 1893 (Jepson Herbarium). *Clarkia amoena* f. *concolor* Nels. & Macbr., Bot. Gaz. 65: 62. 1918. *Godetia lassenensis* var. *concolor* Howell, Leafl. W. Bot. 5: 43. 1947.

Godetia amoena f. *pygmaea* Jeps, U.C. Publ. Bot. 2: 325. 1907. Conn Valley, *Jepson*, May 1, 1894. (lectotype, *Jepson, 13339*. Jepson Herbarium). *Godetia amoena* var *pygmaea* Jeps, Man. Fl. Pl. Cal. 677. 1925.

Distribution (see fig. 6).—CALIFORNIA. Alameda, Amador, Butte, Colusa, Contra Costa. Eldorado, Humboldt, Lake, Marin, Mendocino, Modoc, Napa, Placer, Santa Clara, Shasta, Siskiyou, Sonoma, Sutter, Tehama, Trinity, and Yolo counties OREGON. Benton, Clackamas, Crook, Curry, Douglas, Hood River, Jackson, Jefferson, Josephine, Klamath, Multnomah. Wasco, Washington, and Yamhill counties. WASHINGTON. Klickitat and Walla Walla counties. Open sites in the woodland and adjacent coniferous forest.

Representative specimens.—CALIFORNIA Alameda County: Cedar Mountain, *Elmer 4436*. Butte County: 2.5 miles southeast of Oroville on road to Wyandotte, *Wolf 8663*. Contra Costa County: Jim White Trail to Deer Flat, Mt. Diablo, *Bowerman 3840*. Eldorado County: Kelsey, *Jones* in 1883. Humboldt County: Hills west of South Fork of Trinity River near mouth, *Harris & Tracy 3261*. Lake County: Mt. Sanhedrin, *Hall 9493*. Marin County: Tamalpais, *Brandegee* in 1907 Modoc County: 15 miles north of Alturas (near Surprise), *Hitchcock 6729*. Napa County: Pope Valley Grade, *Brandegee* in 1909. Santa Clara County: Santa Isabella, Santa Clara Valley, *Sharsmith 3726*. Shasta County: 25 miles east of Redding, *Hitchcock 6495*. Siskiyou County: Klamath River, 3 miles north of mouth of Salmon River, *Tracy 16274*. Sutter County: 1 mile south of North Butte, *Embree 39*. Tehama County: Red Bluff to Susanville Road, 7 miles below Paynes Creek P.O , *Wolf 8691*. Trinity County: northeast of Weaverville, *Yates 315*. Yolo County: Cache Creek Canyon, *Baker 2891*. OREGON. Benton County: Corvallis, *Stason 2421*. Crook County: near Camp by Grizzly Butte, *Leiberg 273*. Hood River County: near Wyeth, *Thompson 4214*. Klamath County: south end of Klamath Lake, *Applegate 3512*. Wasco County: old road between Mosier and The Dalles, *Thompson 4325*.

Progenies from the following localities have been studied in the experimental garden. Butte County: 6.4 miles southeast of Oroville city limit on road to Bangor, *393* Colusa County: Highway 20, 3 miles east of the Colusa County line, *67*. Humboldt County: Highway 36, north end of Van Duzen River Bridge, *423* (atypical, see below). Mendocino County: U.S. Highway 101, 5 miles south of Ukiah city limits *82;* 2.1 miles east of Longvale, *86*. Sonoma County: 0.7 mile west of Mark West Spring, *869*. Trinity County: U.S. Highway 299, 0.5 mile west of Trinity River Bridge 5–18, *406;* 1.5 miles north of Hayfork Ranger Station, *410;* Highway 36, 5.3 miles west of Cold Spring Camp Ground, *412*. Yuba County: Highway 20, 0 6 mile east of junction with Smartville road, *59*.

We have examined microsporocytes or root tips of one plant from each of three typical populations (*59*, *86*, and *393*) and population *423* discussed below. All of these had somatic cells with 28 chromosomes or formed 14 pairs at meiosis with no apparent abnormalities. This in agreement with the observations of Håkansson (1942) on material from Roseburg, Oregon.

Population to population differences are apparent, but each progeny grown in the garden has been very uniform except for population *423*. This variable population also differs conspicuously from others of this subspecies in having larger flowers, intermediate in size between subspecies *gracilis* and subspecies *sonomensis*, and the central spot characteristic of subspecies *sonomensis*. In other respects, it is like subspecies *gracilis*. Both the variability and morphology suggest that it may be of hybrid origin involving subspecies *gracilis* and subspecies *sonomensis*. However, this is not necessarily the case. For example, this population could represent the result of hybridization between *C. gracilis gracilis* and *C. amoena huntiana* which is frequent in the same area. On the other hand, hybridization may not be directly involved. An exchange between the parental genomes of which the alloploid *C. gracilis* is composed could lead to similar variation and morphological expression. Regardless of the factors involved, however, this population has retained its particular characteristics for an appreciable length of time to judge from samples from the same locality collected over a period of forty years. The collections of Tracy in 1908, the "Buck Mt." race of Hiorth (1942*a*) collected in 1936, and our collection in 1947 are all from the same site, and are all comparable. Therefore, if this population is of hybrid origin its intermediate character has become relatively stabilized.

Clarkia gracilis gracilis in its typical expression is readily distinguished from the other two subspecies by its small flowers with unspotted petals. These flowers are primarily, if not exclusively, self-pollinated. As a consequence of self-pollination, this subspecies is able to maintain its identity although it is sympatric with both of the other subspecies. Furthermore, variants of subspecies *gracilis* differing in a number of morphological characters can be found growing together in mixed populations. These forms breed true in the garden (e.g., the Selma populations of Hiorth, 1942*a*). A limited amount of natural hybridization probably does occur, however, at least between *C. gracilis gracilis* and *C. gracilis sonomensis*. This is suggested by the occurrence of intermediates. These may be intermediate in flower size and have the petal spot of subspecies *sonomensis* (e.g., CALIFORNIA. Mendocino County: 5 miles south of Hopland, *Tracy 5550*. Humboldt County: lower foothills of Buck Mt. on northwest slope, *Tracy 4091;* near Little Van Duzen River Bridge, northwest slope of Buck Mountain, *Tracy 2680* and *Lewis & Lewis 423*), or they may lack the spot but have large petals (e.g., Hupa Indian Reservation, Humboldt County, *Chandler 1327*). At the same time, plants otherwise typical of subspecies *gracilis* can be found with a petal spot (e.g., Burr Valley on the northwest slope of Buck Mountain, Humboldt County, *Tracy 3907*). All of the variation in this subspecies can hardly be attributed to intersubspecific hybridization, however, since one finds some of the largest-flowered individuals with petals over 2 cm. in length at the extremes of the distribution area and often beyond the range of subspecies *sonomensis* (CALIFORNIA. Santa Clara County: southeast slope of Copernicus Peak, Mt. Hamilton, *Sharsmith 3238*. Alameda County: Cypress Ridge above Livermore, *Van Dyke* in 1931; Cedar Mountain, *Elmer 4436*). *Clarkia gracilis gracilis* also grows in the area of subspecies *albicaulis*, but we have seen no evidence of intermediates.

5*b*. **Clarkia gracilis** subsp. **albicaulis** (Jepson) Lewis & Lewis, Madroño 12: 33. 1953. (Fig. 5, *a*.)

Hypanthium broad, 4–10 mm. long, dark reddish-purple within, the ring of hairs in the lower third; sepals lanceolate, 15–25 mm. long, 3–4.5 mm. broad, united and deflexed to one side at anthesis, sometimes reflexed in pairs; petals fan-shaped, entire to erose or even emarginate, 2–4 cm. long, tricolored, pinkish-lavender to light purple shading to white with a scarlet basal spot; anthers cream, red-spotted; pollen yellow; stigma white with 4 linear lobes; style at maturity somewhat exceeding the stamens, red below, white above; ovary 2–4 cm. long, sessile or on a pedicel as much as 1 cm. long; immature capsule conspicuously 4-grooved, somewhat enlarged in the upper half; mature capsule 3–4 cm. long, 2–3 mm. broad, slightly enlarged above the middle, subterete or somewhat 4-sided, attenuate to a slender beak as much as 1 cm. long.

Type.—Based on the type of *Godetia amoena* var. *albicaulis*, Jepson. Rancho Chico, Butte County, California, *Mrs. Bidwell 122*, May 1878 (Kew).

Godetia amoena var. *albicaulis* Jeps., U.C. Publ. Bot. 2: 329. 1907. *Godetia lassenensis* var. *albicaulis* Howell, Leafl. W. Bot. 5: 44. 1947.

Godetia cylindrica var. *tracyi* Jeps., Fl. Calif. 2: 584. 1936. Type: hills north of Paskenta, southwestern Tehama County, California, *Jepson 16324*, May 9, 1932 (Jepson Herbarium).

Distribution (see fig. 6).—CALIFORNIA. Margins of the Sacramento Valley in Butte, Colusa, Lake, Tehama, and Shasta counties. Usually in oak woodland.

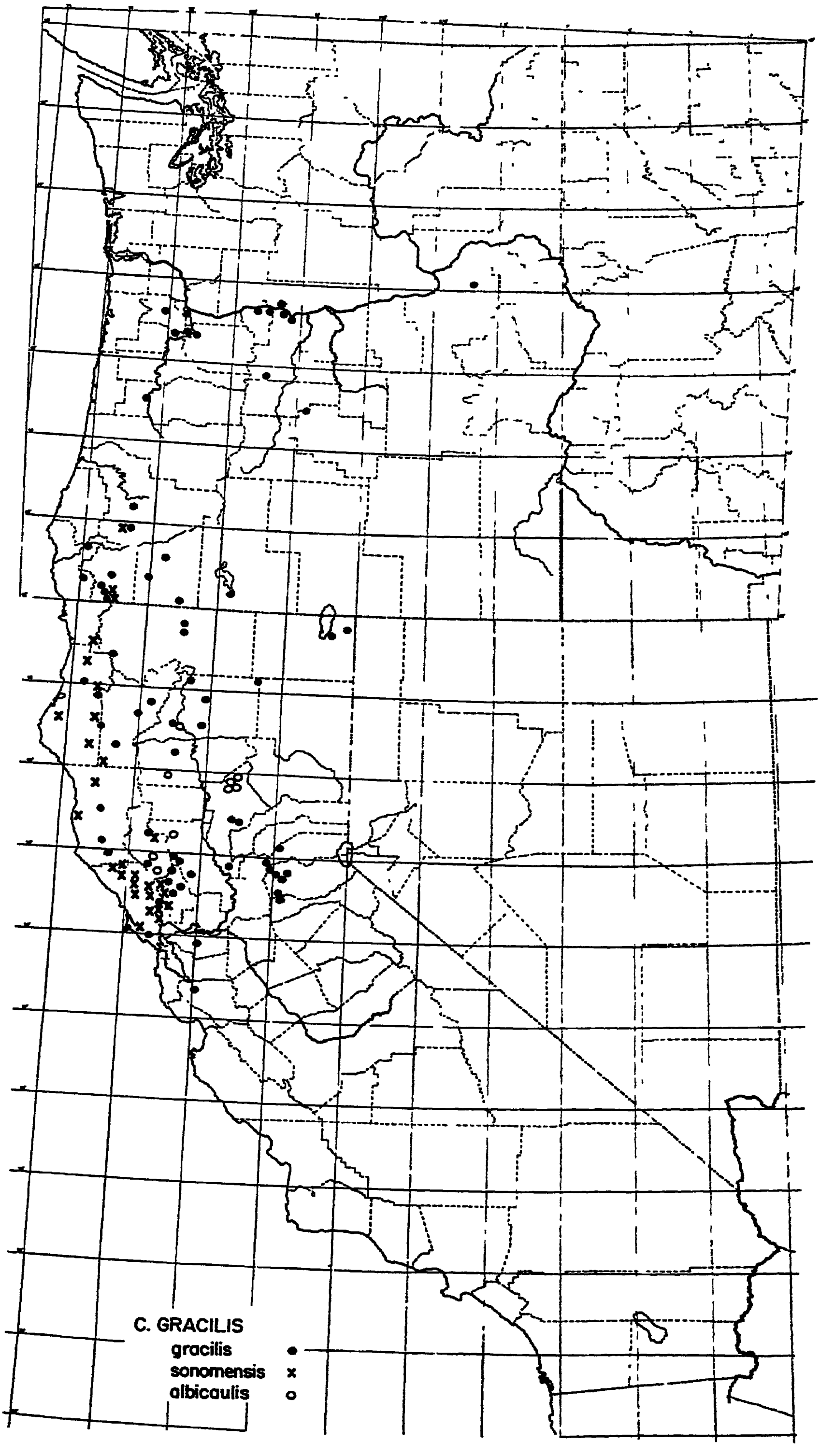


Fig. 6. Distribution of *Clarkia gracilis.*

Representative specimens.—CALIFORNIA. Butte County: 1 mile above Ten Mile House, *Heller 14625;* De Sabla, *Edwards* in 1917. Colusa County: 3 miles west of Leesville, *Heller 12354; Stebbins, Nobs & Rattenbury 3735*. Lake County: 3.8 miles east of Middleton, *Baker 11062;* 2.9 miles east of Middleton, *Baker 12250*.

We have studied one progeny of this handsome race in the experimental garden (road to Butte Creek Canyon, 4.5 miles below Nimshew, Butte County, *855*). Buds from a field collection (*830*) from this same locality showed one plant to have microsporocytes with 14 pairs plus an extra chromosome. Chromosomes in addition to the normal basic set have been reported by Håkansson (1942) for another plant of this same subspecies from Magalia, Butte County.

The population of *C. gracilis albicaulis* grown by us varied conspicuously in the intensity of the petal color and somewhat in petal breadth. To judge from herbarium material, the populations from the Sierra Nevada foothills have large flowers, with petals 3 cm. long or longer, whereas those from the western margin of the Sacramento Valley have petals only 2–3 cm. long. Several herbarium sheets have indicated that this subspecies was growing on serpentine soils, but it is apparently not confined to them.

Clarkia gracilis albicaulis replaces subspecies *sonomensis* geographically (fig. 6). The two are not known to occur together, although they may perhaps be sympatric in Lake and Napa counties. They are readily distinguishable on the basis of flower color pattern. The hybrids produced in the garden combine the color patterns, exhibiting both a central and basal color spot. Subspecies *albicaulis* and the small-flowered, self-pollinating subspecies *gracilis* are sympatric, but no intermediates are known. Hiorth (1942*a*), however, has shown that all of the subspecies are interfertile when crossed in the garden.

Clarkia gracilis albicaulis is similar in several respects to *C. lassenensis* and *C. arcuata*. It can be readily distinguished from the former, however, on the basis of flower size and from the latter on the basis of the pubescence of the calyx and ovary and in the conformation of the immature capsules. *Clarkia gracilis albicaulis* has a 4-grooved immature capsule, whereas that of *C. arcuata* is strongly 8-ribbed. Furthermore, the latter has short glandular hairs on the calyx and ovary; the former is eglandular. We have found these two taxa growing together in Butte County. At this locality, *C. arcuata* bloomed much earlier, barely overlapping that of *C. gracilis albicaulis*, and was a much smaller and more slender plant with smaller flowers.

5c. **Clarkia gracilis** subsp. **sonomensis** (Hitchcock) Lewis & Lewis, Madroño 12: 33. 1953. (Fig. 5, *b*.)

Hypanthium 4–9 mm. long, usually reddish-purple within, the ring of hairs at or below the middle; sepals lanceolate, 15–30 mm. long, 2–4 (5) mm. broad; petals fan-shaped, entire to erose, 20–40 mm. long, pinkish-lavender shading to white below, usually with a brilliant-red central spot; anthers white or pale with red flecks; pollen light yellow; stigma white with 4 linear lobes; style white, exceeding the stamens at maturity; ovary 1.5–3 cm. long, sessile or on a pedicel as much as 5 mm. long; immature capsule 4 or sometimes 8-grooved; mature capsule 2.5–4 cm. long, 3–5 mm. broad, subterete, usually enlarged above the middle, attenuate to a slender beak 2–3 or as much as 5 mm. long.

Type —Based on the type of *Godetia amoena* var. *sonomensis* Hitchcock One-half mile east of Glen Ellen, Sonoma County, California, *Hitchcock 18* (Pomona).

Godetia amoena var *sonomensis* Hitch., Bot. Gaz. 89: 338. 1930. *Godetia lassenensis* var. *sonomensis* Howell, Leafl. W. Bot. 5: 44. 1947.

Distribution (see fig. 6).—CALIFORNIA. Del Norte, Humboldt, Lake, Marin, Mendocino, Napa, and Sonoma counties. OREGON. Douglas and Josephine counties. Usually in open sites in the woodland and coastal forest.

Representative specimens: CALIFORNIA —Humboldt County: Alton, *Tracy 3758*. Napa County: Calistoga, *Brandegee 120*. Sonoma County: Sonoma to Santa Rosa, 0.5 mile south of junction with road to Glen Ellen, *Hitchcock 19;* Sonoma to Santa Rosa Highway, 5.5 miles south of Santa Rosa, *Hitchcock 21;* near Burkes Sanitorium, *Heller 5752*. OREGON Josephine County: Kerby, *Piper 5054;* near Waldo, *Thompson 4682*.

We have studied one progeny in the experimental garden (U.S. Highway 101, 2.3 miles north of Healdsburg city limit, *134*) and have examined three plants cytologically. Chromosome pairing was regular in microsporocytes of two of the plants, but one of these had an extra chromosome. Only root tips of the third plant were examined, but they showed 3 extra chromosomes. These results parallel those of Håkansson (1942; 1945*a*) for individuals of the same subspecies, although he found as many as 4 extra chromosomes.

Relationship.—*Clarkia gracilis* is an alloploid species which combines genomes of *C. amoena* (Håkansson, 1942) and *C. lassenensis*. The subspecies of *C. gracilis* combine in different ways the morphological traits of the two diploid parents. The geographical distribution of *C. gracilis* extensively overlaps that of both *C. amoena* and *C. lassenensis* and the distribution of the two parental species overlaps at present in a small area in Humboldt and Trinity counties, California.

Clarkia gracilis sonomensis is very much like *C. amoena huntiana* in flower size and markings, particularly in areas where the two taxa are sympatric. This may indicate that they are exchanging genetic materials or it may mean that individuals possessing these traits are particularly well adapted to the area in which the taxa are sympatric. *Clarkia gracilis* is most readily distinguished from *C. amoena* by its drooping leaders and clavate rather than cylindrical capsules.

SECTION GODETIA SEC. NOV.

Erect or prostrate herbs; stems puberulent to glabrous; rachis of the inflorescence erect; buds erect; hypanthium funnelform or obconical, 2–15 mm. long, the ring of hairs in the lower third; sepals reflexed in pairs or individually; petals obovate to fan-shaped, the claw inconspicuous or absent; stamens 8, in two similar series; anthers obtuse; filaments erect; immature capsule conspicuously 8-ribbed.

Type species.—*C. purpurea* (Curtis) Nels. and Macbr.

Godetia as a genus, Spach, Hist. Veg. Phan. 4: 386. 1835.

Section Godetia consists of a diploid series, *C. imbricata*, *C. williamsonii*, *C. nitens*, and *C. speciosa*, a tetraploid series, *C. davyi* and *C. tenella*, and a hexaploid series, *C. purpurea* and *C. prostrata*. Both the tetraploid and hexaploid series have probably resulted from intrasectional hybridization.

Relationship.—Section Godetia is similar in many respects to Section Primigenia and has almost certainly been derived from it. The morphological characters, which are typical of Godetia, are found among the species of Primigenia. For example, the erect buds and rachis, constant characters in Godetia, are found in *C. amoena* and *C. rubicunda*, whereas the conspicuously 8-ribbed ovary of Godetia is found in *C. arcuata*. Other characters, such as petal shape, are common to both sections. On the other hand, constant differences between the sections, such as the shape of the anthers, also occur. The derivation of the species in Godetia from a Primigenia-like stock has involved an increase in chromosome number from 7 to 8 and 9 followed by polyploidy. Godetia is apparently not directly related to any other section except through alloploidy (see Section Biortis).

6. **Clarkia imbricata** Lewis & Lewis, Madroño 12: 38. 1953. (Fig. 8, *c*, *d*.)

Erect, as much as 6 dm. tall; stems simple or with numerous short branches in the upper parts, sometimes with a few large branches from the base, sparsely puberulent above, glabrate below, densely leafy; leaves lanceolate, 2–2.5 cm. long, 4–7 mm. broad, entire to denticulate, ascending, overlapping, longer than the internodes, sessile or on petioles less than 2 mm. long; inflorescence congested, the rachis erect; buds erect; hypanthium conspicuous, 1–1.5 cm. long, funnelform, as much as 1 cm. broad, conspicuously veined, lavender striate within, the ring of hairs about 3 mm. above the base; sepals lanceolate, 1–1.5 cm. long, 3–5 mm. broad, remaining united in pairs or reflexed individually; petals fan-shaped, 2–2.5 cm. long, lavender above, pale lavender to nearly white below, light purple at the base with a conspicuous v-shaped purple spot which extends from the middle to the upper margin of the petal; stamens 8, lavender; filaments of the outer series about twice the length of the inner; pollen white; stigma lobes 2 mm. long, dark purple; mature style exceeding the stamens; immature capsule 1–1.5 cm. long, 4–5 mm. broad, sessile, conspicuously and deeply 8-ribbed; mature capsule ribbed, 3 mm. broad, the beak short, less than 1 mm long; seeds brown or gray, scaly, 2 mm long, the crest less than 0.2 mm. long.

Type.—Roadside at 6230 Vine Hill Road, between Santa Rosa and Guerneville, Sonoma County, California, *Lewis & Lewis 865*, July 10, 1951 (U.C.L.A.).

Distribution (see fig. 7).—CALIFORNIA. Known only from one small area in Sonoma County, between Santa Rosa and Guerneville: Pitkin Ranch along path to marsh, *M. S. Baker 11107;* Pitkin Marsh, *Howell 21315;* and the type locality which is adjacent to the Pitkin Ranch.

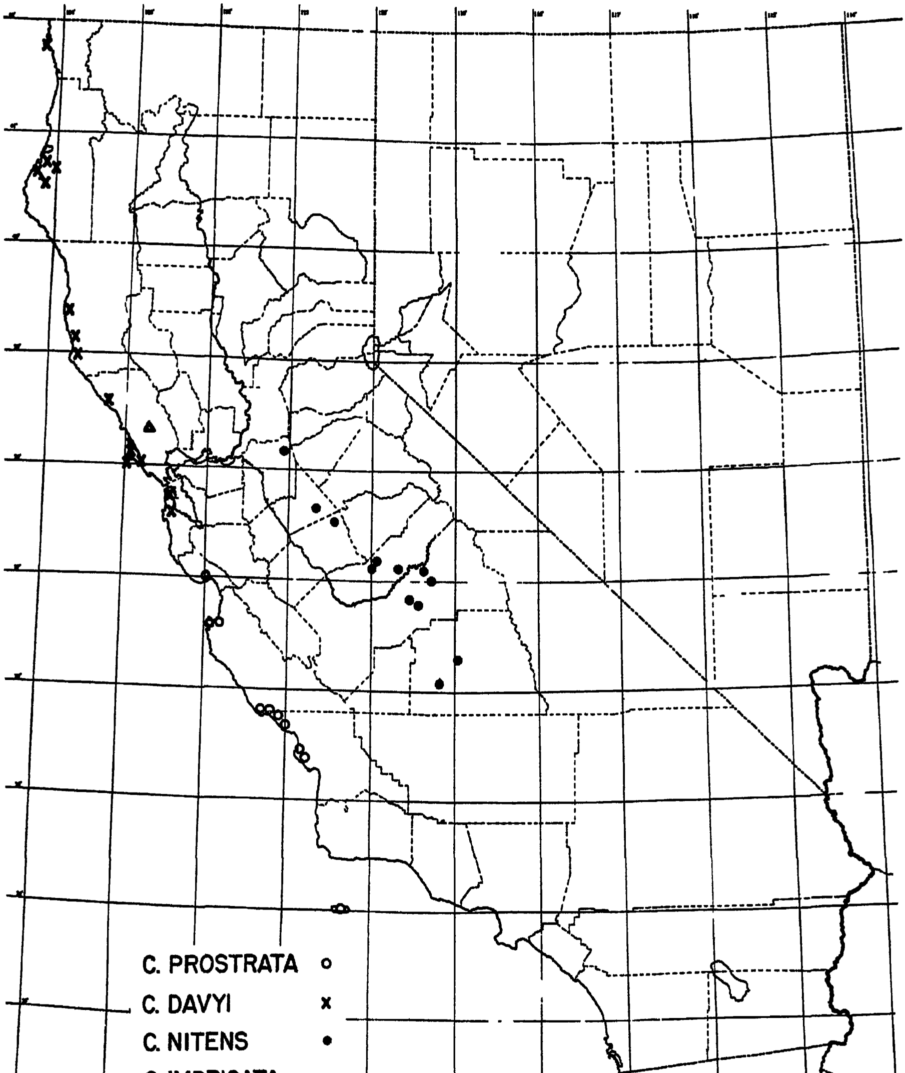
A progeny derived from seeds from the type collection has been studied in the experimental garden. The haploid chromosome number is 8, based upon examination of microsporocytes from this population. No meiotic irregularities were observed.

Relationship.—*Clarkia imbricata* is morphologically similar to *C. nitens*, *C. speciosa*, *C. williamsonii*, and certain forms of *C. purpurea*, but it differs from all of these in chromosome number. It can be distinguished from the first two species by the color pattern of the petals and from *C. williamsonii* and those forms of *C. purpurea* which it closely resembles in flower size and petal color pattern, by the broad, ascending, overlapping leaves.

Clarkia imbricata has morphological characters of the sort that could have combined with a species comparable to *C. speciosa* with a genome of 9 chromosomes to give rise to *C. tenella* or the stock from which *C. tenella* and *C. davyi* have been differentiated. If so, *C. imbricata* may represent a relictual fragment of a relatively old species of the genus.

7. **Clarkia williamsonii** (Durand & Hilgard) Lewis & Lewis, Madroño 12: 34. 1953. (Fig. 8, *f*.)

Erect, as much as 1 m. tall; stems simple or branched above and below, puberulent above with short, upwardly curled hairs, sometimes with longer, spreading hairs, glabrate to sparsely puberulent below; leaves linear to narrowly oblanceolate, entire or nearly so, 2–5 (7) cm. long, 2–5 mm. broad, not crowded, puberulent on both surfaces, sometimes sparsely so, sessile or narrowed to petioles as much as 10 mm. long; inflorescence not congested; rachis of the inflorescence erect; buds erect; calyx often pilose with scattered, long spreading hairs; hypanthium 7–13 mm. long, not conspicuously colored within, the ring of hairs in the lower third; sepals lanceolate, 8–18 mm. long, 2–4 mm. broad, free at the tip in bud, reflexed individually or in pairs at anthesis; petals fan-shaped, entire to erose at the summit, 1–3 cm. long, lavender near the upper margin and near the base, white near the center, with a purple wedge- or shield-shaped spot in the upper half, the entire petal



CALIFORNIA—NEVADA

Fig. 7. Distribution of *Clarkia nitens*, *C. imbricata*, *C. davyi*, and *C. prostrata*.

wine red in one form; stamens 8; filaments of the outer series about twice the length of the inner; anthers white to lavender; pollen white; stigma prominently 4-lobed, lavender to dark purple; mature style exceeding the stamens; immature capsule 1–3 cm. long, 4–5 mm. broad, conspicuously 8-ribbed, sessile or nearly so; mature capsule 1.5–3 mm. broad, the beak short, less than 2 mm. long; seeds brown or grayish, scaly, 1–1.5 mm. long, the crest about 0.1 mm. long.

Type.—Based on the type of *Godetia williamsoni* Dur. & Hilg. Fort Miller, California, *Heermann* (Philadelphia).

Godetia williamsoni Dur. & Hilg., Pac. R. Rep. 5 (3): 7, pl. 5. 1855. *Oenothera auricula* var. *tenella* subvar. *williamsoni* Lév., Monog. Oenoth. 271. 1908.

Godetia viminea var. *congdonii* Jeps , U.C. Publ. Bot. 2: 338. 1907. Type: Hetch Hetchy, Tuolumne County, California, *Congdon 15*, July 7, 1896 (U.C. Berkeley).

Godetia viminea var. *incerta* Jeps., U.C. Publ. Bot. 2: 339. 1907. Type: Yosemite Valley, California, *Jepson*, July 1896, later numbered *14365* (Jepson Herbarium).

Distribution (see fig. 9).—CALIFORNIA. Amador, Calaveras, Eldorado, Fresno, Madera, Mariposa, Nevada, Placer, and Tuolumne counties. Foothills of the Sierra Nevada, primarily in oak-digger pine woodland.

Representative specimens.—CALIFORNIA. Amador County: 5 miles northeast of Jackson, *Hitchcock 31*. Eldorado County: near Fyffe, *Brandegee* in 1908. Fresno County: Pine Ridge, *Hall & Chandler 203*. Madera County: Fresno Flats on Fresno River, 1 mile southwest of Oakhurst, *Constance 2346* (f. *incerta*); Along Friant-North Fork Road 1.5 miles east of Bellview west of O'Neals, *Ferris & Bacigalupi 10379*. Mariposa County: Yosemite Valley, *Abrams 4510* (f. *incerta*); 0.5 mile west of Wawona near Merced River, *Hitchcock & Martin 5456*. Nevada County: near Wolf Creek, *Eastwood 3442*. Tuolumne County: *Hetch Hetchy, Congdon 15;* Hog Ranch, Mather, *Keck and Heusi 300*.

Progenies from the following localities have been studied in the experimental garden. Amador County: Jackson, *160*. Fresno County: 1.6 miles south of Dunlap on road to Miramonte, *318A*. Madera County: Highway 41, 2.6 miles north of road to O'Neals, *324*. Mariposa County: Wawona, *130;* Yosemite Valley at base of El Capitan, *904*, *905*. Tuolumne County: Cottonwood Trail above Hog Ranch, Mather, *96*.

Clarkia williamsonii is a relatively uniform species aside from rather conspicuous color variants and relatively minor variations in pubescence. The progeny grown in the garden from locality *318A* did not have the spectacular colors typical of the species. The color pattern was the same but the colors were very pale. The most conspicuous variant, however, is a dark wine-red flowered form (*904*, *905*). This variant is apparently centered about Yosemite Valley (*Cook & Reynolds* in 1900; *Tompkins* in 1894; *Stanford 1156; Redfield 110; Congdon* in 1890; *Bacon* in 1902; *Hall* in 1900; *Eastwood* in 1923) but also occurs in other areas (e.g., 1 mile southwest of Oakhurst, Madera County, *Constance 2346*). Within Yosemite Valley it may occur to the exclusion of other forms. When grown in the experimental garden it is indistinguishable from typical *C. williamsonii* except by the very dark color. It has the characteristic wedge- or shield-shaped spot in the upper part of the petal, but this is obscured by the over-all dark color. We have not been inclined to give formal recognition to local color variants in most cases, but because of the spectacular nature of this variant, together with its geographical distribution, one may wish to distinguish it from the typical aspect of the species (**C. williamsonii** forma **incerta** [Jeps.] Lewis & Lewis comb. nov., based on the type of *Godetia viminea* var. *incerta* Jepson). The variation in pubescence within the species is most conspicuous with respect to the presence or absence of long spreading white hairs on the calyx. This may vary within as well as between populations.

The haploid chromosome number is 9 (Håkansson, 1941*b*, as *G. viminea*). Our counts are based upon examination of microsporocytes of one individual from population *318A*, two from *904* and root tips of two individuals from *324*. No meiotic irregularities were observed. Håkansson (1949) found individuals with 1 to 3 extra chromosomes. These, as well as normal diploids, showed a degree of asyndesis. He also observed one or two small fragments in a few plants with 18 chromosomes. A hybrid that we obtained between *C. williamsonii* (*160*) and *C. speciosa* (*46*) had two extra chromosomes, but we do not know from which parent the additional chromosomes were derived.

Relationship.—*Clarkia williamsonii* is morphologically similar to some populations of *C. purpurea viminea*, and the two taxa have been confused. The latter, however, is hexaploid (n = 26) and can usually be distinguished from the former by the tips of the sepals which are free in *C. williamsonii* and are united in *C. purpurea*. The close similarity between *C. williamsonii* and some populations of *C. purpurea viminea* in the Sierra Nevada foothills might be explained on the basis of occasional hybridization between them. The hybrid is quite sterile, although we have obtained progenies by backcrossing, particularly to the hexaploid parent. However, *C. purpurea viminea* from areas far removed from *C. williamsonii* may be scarcely distinguishable from it short of counting the chromosomes (e.g., 1.9 miles south of Olema, Marin County, *Lewis & Lewis 440*). This suggests that *C. williamsonii*, or a species very similar to it, may be one of the parental species of *C. purpurea*. The flowers of *C. williamsonii* are also similar to those of *C. imbricata*, and the two are doubtless closely related, although they differ in chromosome number. They can be distinguished by the broad overlapping leaves of the latter. *Clarkia williamsonii* is easily confused with *C. nitens* and *C. speciosa* in herbarium collections, but they are readily distinguished on the basis of color pattern of the petals in fresh material. *Clarkia williamsonii* and *C. nitens* occur sympatrically, and no intermediates have been found. The hybrids between *C. williamsonii* and each of the subspecies of *C. speciosa* are highly sterile. These hybrids have a variable and irregular meiosis, suggesting that the chromosomes of the two species differ by a number of structural rearrangements.

8. **Clarkia nitens** Lewis & Lewis sp. nov. (Fig. 8, *a*, *b*.)

Herba erecta altitudine ad 6 dm.; caulibus simplicibus vel ramosis; foliis lanceolatis, 1.5–4 cm. longis, 2-5 mm. latis, integris vel subintegris, sessilibus, inflorescentium axe erecto; floribus crebris; calycis tubo infundibuliformo, 7–12 mm. longo, ad 6 mm. lato, annulo pilorum infra medium posito, limbo 10–12 mm. longo, 2–3 mm. lato; petalis flabelliformis 10–22 mm. longis, roseo-pupureis vel luteolis, maculis purpureo-rubris in medio posito vel sine maculis; staminibus 8, sufflavis, quam stylus brevioribus, stigmate quadrifido; ovario 8-costato; capsula 1.5–2 cm. longa, 1.5–2 mm. lata; seminibus fuscis vel canescentibus et squamosis, crista brevi, plus minusve 0 1 mm. longa.

An erect herb as much as 4 dm. tall, unbranched or with numerous branches near the base, puberulent at least above; leaves lanceolate, 1.5–4 cm. long, 2–5 mm. broad, entire or essentially so, usually longer than the internodes, sessile; inflorescence crowded, the rachis erect; buds erect; hypanthium conspicuous, 7–12 mm. long, funnelform, as much as 6 mm. broad, not conspicuously colored within, the ring of hairs about 3 mm. above the base; sepals lanceolate, 10–12 mm. long, 2–3 mm. broad, usually reflexed individually; petals fan-shaped, 10–22 mm. long, lavender near the upper margin, cream to pale yellow below, sometimes cream or straw-colored throughout, unspotted or with a bright purplish-red spot in the lower half, sometimes merely penciled; stamens 8, cream or pale yellow; filaments of the outer series about twice the length of the inner; pollen cream; stigma 4-lobed, the lobes 1–2 mm. long, yellow or purple; mature style exceeding the stamens; immature capsule 1.5–2 cm. long, 3 mm. broad, strongly 8-ribbed; mature capsule 1.5–2 mm. broad; seeds brown or grayish, scaly, 0 7–1 0 mm. long, the crest about 0.1 mm. long.

Type.—2.8 miles north of Highway 168 on the road to Auberry, Fresno County, California, May 16, 1954, *Lewis & Thompson 954* (U.C.L.A.).

Distribution (see fig. 7).—CALIFORNIA. Fresno, Madera, Merced, San Joaquin, Stanislaus, and Tulare counties. Oak-digger pine woodland in the foothills of the Sierra Nevada.

Specimens examined.—CALIFORNIA. Fresno County: Sanger, *Condit* in 1910; Clovis, *Smiley* in 1911; west of Burrough Valley on road to Huntington Lake, *Wolf 5073;* Big Sandy Creek, *McDonald* in 1915. Madera County: near Raymond on road to Coarsegold, *Hoover 3518;* west of Raymond, *Dudley* in 1906; Raymond, *Howell 13857;* near Raymond, *Tompkins* in 1894; 1.2 miles south of road to O'Neals on Highway 41, *Epling 242;* 2 miles west of Bellview on Friant–North Fork

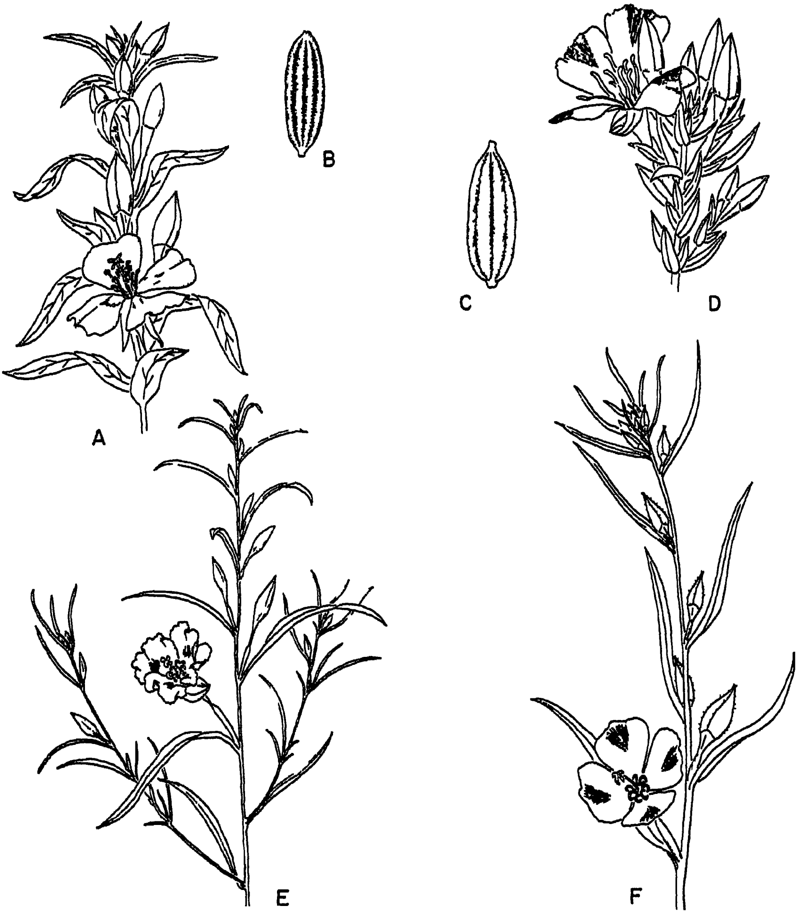


Fig. 8. *a*, *Clarkia nitens*, inflorescence × 1½; *b*, capsule × 1; *c*, *C. imbricata*, capsule × 1; *d*, inflorescence × 1½; *e*, *C. speciosa* subsp. *speciosa*, inflorescence × 1½; *f*, *C. williamsonii*, inflorescence × ½.

Road, *Ferris & Bacigalupi 10376*. Merced County: Hopetown Bridge, *Howell 1065;* Merced River Bridge on the Amsterdam to Snelling road, *Lewis, Lewis, & Mathias 853*. San Joaquin County: Live Oaks, Mokelumne River, *Rattan* in 1885 and 1886. Stanislaus County: 10 miles east of Waterford, *Hoover 1235;* Gobin Ranch, 13 miles east of Waterford, *Hoover 623*. Tulare County: 10 miles east of Exeter on road to Yokohl Valley, *Wolf 4711;* South Fork of Kaweah River, *Culbertson 4507*.

Progenies from two localities have been studied in the experimental garden: Highway 41, 2.6 miles north of road to O'Neals, Madera County, *325*, and the Merced River Bridge on the Amsterdam to Snelling road, Merced County, *853*.

The haploid chromosome number is 9 based upon root-tip counts of one plant of *325* and microsporocytes of two individuals from *853*. No meiotic irregularities were observed.

The plants grown under cultivation varied chiefly with respect to flower color and pattern, including varying amounts and intensity of lavender in the upper part of the petal, the expression of the spot, and the color of the stigma. One plant in population *853* was pleasantly fragrant, and it is the only instance in which we have encountered a marked fragrance of any sort in the genus.

Relationship.—*Clarkia nitens* is closely related to *C. imbricata*, *C. williamsonii*, and *C. speciosa*. It differs from the first of these in having 9 rather than 8 chromosomes, somewhat narrower leaves, and in the color pattern of the petals. Furthermore, they occur in widely separated areas. *Clarkia nitens* is difficult to distinguish from *C. williamsonii* among herbarium collections, although they are conspicuously different and readily distinguished when growing together in the wild or in the garden. The position, shape, and color of the petal markings are very distinct, and the flowers and leaves of the former are congested, whereas those of the latter are lax. However, in many of the depauperate populations that are found in nature the vegetative differences may not be apparent. *Clarkia nitens* is also easily distinguished from *C. speciosa* in the garden. The former has heavier stems and a coarser habit with congested leaves and flowers. The flowers of *C. nitens* are on the whole larger and lighter in color than *C. speciosa*, although the two species have parallel color variants. The differences in habit are obscured in depauperate individuals. *Clarkia nitens* might also be confused with the allohexaploid species *C. purpurea* in the herbarium but never as living material. They differ conspicuously in color pattern of the petals.

9. **Clarkia speciosa** Lewis & Lewis, Madroño 12: 34. 1953. (Fig. 8, *e*.)

Erect to decumbent; stems as much as 6 dm. long, usually branched at least from the base, sparsely to densely puberulent above with short, upwardly curled hairs, glabrate to sparsely puberulent below; leaves linear to narrowly lanceolate, entire or nearly so, 1–6 cm. long, 2–6 mm. broad, sparsely puberulent, sessile or on petioles as much as 5 mm. long; rachis of the inflorescence erect; buds erect; hypanthium funnelform, 5–15 mm. long, yellowish, sometimes pink to dark reddish-purple within; the ring of hairs in the lower half; sepals lanceolate, 6–15 (17) mm. long, 2–4 mm. broad, remaining united and deflexed to one side or reflexed individually or in pairs at anthesis; petals fan-shaped, subentire to erose, 1–2.5 cm. long, purplish-red with a white or yellow base, to lavender shading to cream at the base, or cream throughout, usually with a bright-red or purplish-red spot in the center or toward the base, the spot sometimes obscured in the darker flowers; stamens 8; filaments of the inner series about half as long as the anthers; anthers white to purple; pollen cream or pale yellow; stigma prominently 4-lobed, lavender (rarely white) to dark purple or red; mature style longer than the stamens; ovary slender, puberulent, 8-ribbed, 5–15 mm. long, sessile or nearly so; mature capsule 4-sided to quadrangular, 1–2 (2.5) cm. long, 1–2 mm. broad, sometimes with a short beak; seeds brown or grayish, scaly, 0.7–1.0 mm. long, the crest not more than 0.1 mm. long.

Type.—Based upon the type of *Oenothera viminea* var. *parviflora* Hook. and Arn. Monterey-San Francisco, California, *Douglas* (Kew).

Clarkia speciosa is a polytypic species with respect to morphological characters and fertility relationships. The subspecies indicated below on morphological grounds are at the same time separated by internal barriers to gene exchange. We have not designated these taxa as species, however, inasmuch as the morphological differences are not always definitive and, in fact, may be completely lost in herbarium material.

KEY TO THE SUBSPECIES

A. Petals lavender to pink above, cream in the lower half, unspotted...... 9*b*. subsp. *immaculata*
AA. Petals pale yellow to lavender or dark purplish-red with a bright-red or purplish-red spot in the middle or near the base, the spot sometimes obscured in the darker flowers.
  B. Flowers purplish-red to lavender or cream, the spot bright red; well-developed plants in the garden are low, much branched throughout, the ultimate branches with few flowers; plants of the South Coast Ranges, California.. .... 9*a*. subsp. *speciosa*
  BB. Flowers purple or purplish-lavender shading to pale lavender or cream, the spot dark purplish-red; well-developed plants in the garden have wandlike, many-flowered branches; plants of the foothills of the southern Sierra Nevada and adjacent mountain ranges 9*c*. subsp. *polyantha*

9*a*. Clarkia speciosa subsp. speciosa. (Fig. 8, *e*.)

Erect to decumbent; stems as much as 6 dm. long, usually branched throughout; petals 1–2 cm. long, purplish-red to lavender, white or cream-colored near the base, sometimes white or cream throughout, with a bright-red spot near the center or toward the base, the spot often obscured or absent in the bright purplish-red petals.

Oenothera viminea var. *parviflora* Hook. & Arn , Bot. Beech. Voy. 342. 1840. *Godetia parviflora* Jeps. U.C. Publ. Bot. 2: 339. 1907.

Godetia viminea var. *margaritae* Jeps , U.C. Publ. Bot. 2: 339. 1907. Type: Santa Margarita Valley, San Luis Obispo County, California, *Mrs. R. W. Summers 373* (Jepson Herbarium). *Godetia parviflora* var. *margaritae* Hitch., Bot. Gaz. 89: 350. 1930.

Godetia parviflora var. *luteola* Hitch., Bot. Gaz. 89: 349. 1930. Type: top of grade on road between Atascadero and Morro Beach, San Luis Obispo County, California, *Hitchcock 40*, June 17, 1928 (Pomona).

Distribution (see fig. 9).—CALIFORNIA. Monterey, San Benito, San Luis Obispo, and Santa Barbara counties. Open sites in the oak woodland.

Representative specimens.—CALIFORNIA. Monterey County: Tassajara Hot Springs, *Elmer 3193;* San Antonio Valley between Jolon and San Antonio Mission, *Abrams 6487;* Jolon, *Brandegee 77.* San Luis Obispo County: Willow Creek Road about 2 miles northeast of German Church on road to Adelaida, Santa Lucia Mountains, *Ferris 9764;* road between Atascadero and Morro at summit of grade, *Hitchcock 40;* 3 miles south of Atascadero, *Hitchcock 8.*

Progenies from the following localities have been studied in the experimental garden. Monterey County: Pleyto Road, 0.3 mile south of junction with Bradley-Jolon Road, *490;* 7.1 miles west of Hunter Liggett Headquarters on road to Indian Guard Station, *495.* San Luis Obispo County: Salinas River Bridge on the Santa Margarita to Creston road, *44;* 1.4 miles east of junction of Parkhill Road with the Santa Margarita to Creston road, *46;* Parkhill Road, about 1 mile east of junction with the Santa Margarita to Creston road, *487* Santa Barbara County: Highway 150, 8.1 miles west of Buellton, *863.*

Populations of *Clarkia speciosa speciosa* from the Santa Lucia Mountains, Monterey County, are very uniform. The flowers are a rich purplish-red and the petal spot is obscure. On the other hand, the populations from San Luis Obispo County in the Salinas River drainage are extremely variable with respect to petal color. Plants with the bright purplish-red petals like those from the Santa Lucia Mountains occur in the same population with plants having pale yellow or nearly white petals and a brilliant spot of red in the center. These plants with paler petals have been given formal recognition (*Godetia parviflora* var. *luteola* Hitchcock). Certain populations may consist predominantly of this color form but the vast majority of populations in the region in which this variant occurs are extremely variable with most of the individuals representing intermediates of various degrees. In the garden, the progeny from a single individual may include both extreme color expressions as well as a vast array of intermediates with scarcely two individuals alike.

The haploid chromosome number is 9, based upon root-tip counts of an individual from population *487* and one from *490.* Håkansson (1941*b*) studied meiosis in a plant (*Godetia parviflora*) which is probably referable to this subspecies. Microsporocytes of this plant formed 7 pairs, a chain of 3, and one univalent. The peculiar chain of 3 and univalent configuration occurs sporadically in two other species, *C. amoena* (Håkansson 1942) and *C. unguiculata* (Lewis, 1951). A hybrid which we produced between *C. speciosa speciosa* (*46*) and *C. williamsonii* (*160*) had two extra chromosomes, but the source of the additional chromosomes is unknown.

A disjunct population of *C. speciosa speciosa* occurs in Santa Barbara County about 8 miles west of Buellton (*863*). These plants are more intricately branched, more prostrate, and compact in habit than the more northern populations when both are grown under comparable conditions in the experimental garden. The color pattern of the flowers of the Buellton population is very similar to that of plants from the Santa Lucia Mountains, but the flowers are somewhat smaller, brighter red, and more yellow at the base. The petals of the Buellton population have a smoother texture, and a red spot is not evident in most of the plants.

9*b*. **Clarkia speciosa** subsp. **immaculata** Lewis & Lewis subsp. nov.

Herba erecta vel decumbens; caulibus ad 5 dm. longis, ramosis; petalis 15-25 mm. longis, superne roseo-purpureis et ad basim ochroleucis vel luteolis, sine maculis.

An erect or decumbent herb; stems as much as 5 dm. long, usually branched throughout; petals 1.5–2.5 cm long, the pinkish or reddish-lavender of the upper part streaking into the white or cream-colored lower half or third, unspotted.

Type.—Carpenter Canyon Road, 3.8 miles south of Edna School, San Luis Obispo County, California, June 24, 1947, *Lewis & Lewis 469* (U.C.L.A.).

Distribution (see fig. 9).—CALIFORNIA. Known only from a restricted area in San Luis Obispo County where it frequently occurs on old sand dunes.

Specimens examined.—CALIFORNIA. San Luis Obispo County: between Pismo and Arroyo Grande, 1.5 miles from Arroyo Grande, *Hitchcock 42;* sand hills near Pismo, *Abrams 6519* and *6520;* Price Canyon, *Brandegee 126, Condit & Brandegee* in 1911; Price Canyon, 1 mile south of Edna, *Hitchcock 4;* Price Canyon, 3 miles south of Edna, *Hitchcock 36;* coast hills, *Summers* in 1884.

Progenies from the type collection have been studied in the experimental garden. The haploid chromosome number is 9, based upon examination of microsporocytes of one and root tips of another of these plants. No meiotic irregularities were observed.

An occasional variant in petal color pattern has been observed both in the field and in the garden. These variants have a small wedge-shaped darker spot of color at the upper margin. An apical spot is otherwise unknown in *C. speciosa* and may in this case be indicative of past hybridization with *C. purpurea.* The hybrid between these two species is nearly sterile in the garden, but small progenies can be produced by backcrossing.

Clarkia speciosa immaculata is very similar to subspecies *speciosa,* except that the flowers are somewhat larger on the average and the petal color pattern is conspicuously different. But this difference in color pattern is no greater than that between the extremes which we have retained in subspecies *speciosa.* However, subspecies *immaculata* and *speciosa* have distinct but adjacent geographical distributions, and no mixed colonies are known. Furthermore, the few crosses we have made between these two subspecies indicate considerable genetic differentiation. The F_1 hybrids are readily obtained and quite fertile, but the F_2 is largely weak and sterile. Subspecies *immaculata* is the entity designated as *Godetia parviflora* var. *margaritae* by Hitchcock (1930), except for the type specimen of the latter (Santa Margarita Valley, San Luis Obispo County, *Mrs. R. W. Summers*), which should unquestionably be referred to *C. speciosa,* subspecies *speciosa.*

9c. **Clarkia speciosa** subsp. **polyantha** Lewis & Lewis subsp. nov.

Herba erecta; caulibus ad 6 dm. longis, gracilis, multifloris, simplicibus vel ramosis; petalis 1.0–2.7 cm. longis, purpureis saepe pallidis vel sufflavis, maculis purpureo-rubris.

An erect herb; stems as much as 6 dm. long, wandlike, many-flowered; petals 1.0–2.7 cm. long, purple or lavender, often yellowish, usually lighter near the base, with a conspicuous purplish-red spot near the middle.

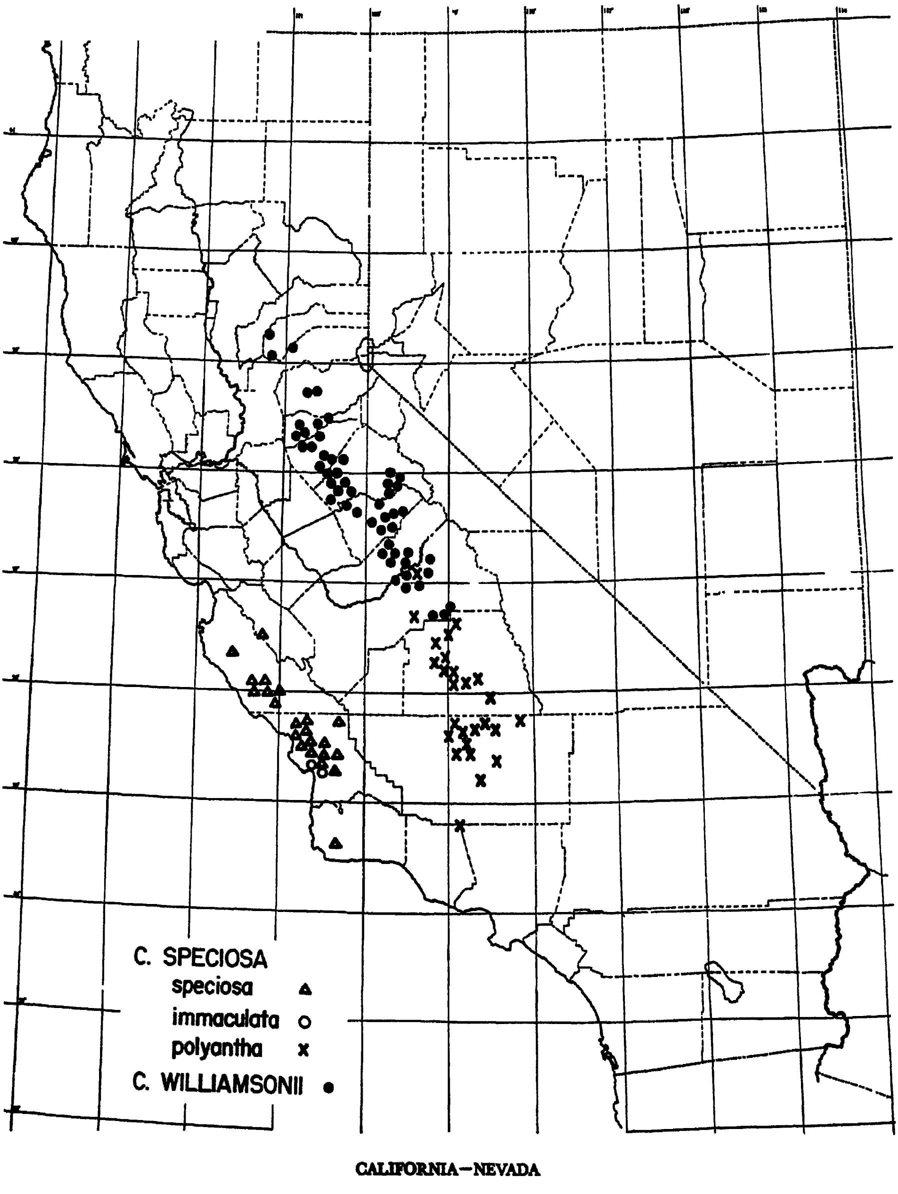


Fig. 9. Distribution of *Clarkia speciosa* and *C. williamsonii.*

Type.—South Fork of the Kaweah River, 5.1 miles from the old road to Sequoia, 0.7 mile below the road to Grouse Valley, Tulare County, California, *Lewis & Thompson 956,* May 17, 1954 (U.C.L.A.).

Distribution (see fig. 9).—CALIFORNIA. Fresno, Kern, and Tulare counties. Associated with oak-digger pine woodland.

Representative specimens.—CALIFORNIA. Fresno County: cemetery near Toll House, *Brandegee* in 1910; Toll House, *Hall & Chandler 15.* Kern County: Tejon Pass, *Mason 5355;* 5 miles west of Kernville, *Bacigalupi & Ferris 2470;* 10 miles south of Woody, *Benson 3632;* Kern River Canyon Road, 4.9 miles west of Bodfish, *Lewis, Ernst, & Vasek 848.* Tulare County: North Fork of Tule

River, 0.5 mile above Milo, *Wolf 5020;* roads end, Tobias Creek, *Silva 107;* Sequoia National Forest, *Davidson 1651;* the Exeter to Springville road, 1.5 miles west of County Fire Patrol Station, *Lewis & Lewis 295;* Kaweah River Road to Badger, 3 5 miles north of Homer Ranch, *Lewis & Lewis 304.*

Progenies from the following localities have been studied in the experimental garden. Kern County: the Bodfish to Havilah road, 2.3 miles south of the road to Piute Peak, *839.* Tulare County: the Exeter to Springville road, 16.4 miles from Exeter, *294;* Kaweah River, 2 1 miles west of Sequoia National Park boundary, *610.*

The haploid chromosome number is 9, based upon root-tip counts of one individual of population *294* and microsporocytes of one individual of *839.* No meiotic irregularities were observed.

Under the favorable and uniform conditions of the garden this subspecies differs conspicuously in habit from the two preceding. The wandlike branches, with as many as nine open flowers on each, offer a striking contrast to the intricately branched plants of the other subspecies which at most have but three or four flowers open at one time on a given branch. These differences are often obscured in nature, for one frequently finds populations in which the most robust individual does not produce more than five or six flowers during the season, and sometimes only one or two. The flower color is definitive for distinguishing living plants. The petals of this subspecies are duller in color and more purplish than in the others, and the spot is a purplish-red rather than bright red. This difference is certainly not apparent on most herbarium sheets. Nevertheless, subspecies *polyantha* is geographically and perhaps genetically isolated from the subspecies in the Coast Ranges. Hybrids between this subspecies and each of the others are essentially sterile. But intraspecific sterility is not uncommon in this genus and the morphological similarity of these taxa is so close that it seems best, at least for the present, to recognize them as geographical races or subspecies.

Relationship.—Clarkia speciosa is closely related to the diploid species *C. nitens* and *C. williamsonii,* both of which occur adjacent to it in the Sierra Nevada foothills. *Clarkia speciosa* is most similar to *C. nitens* in flower color pattern, and each shows comparable variation; but they differ conspicuously in habit and leaf texture. *Clarkia speciosa* differs from *C. williamsonii* in habit as well as flower color pattern. Chromosome pairing in the hybrid between *C. speciosa* and *C. williamsonii* is highly irregular and shows frequent rings, chains, and unpaired chromosomes.

Clarkia speciosa speciosa is probably the diploid parent of the allohexaploid species *C. prostrata,* as is indicated by its morphology as well as chromosome number (see *C. prostrata*). In addition, *C. speciosa,* or a species much like it, may have been one of the parents of the allotetraploid species *C. tenella.*

10. **Clarkia tenella** (Cavanilles) Lewis & Lewis, Madroño 12: 34. 1953. (Fig. 11, *a*.)

Erect or decumbent herbs as much as 5 dm tall; stems simple or branched, sparsely to densely puberulent above, glabrate or sparsely puberulent below; leaves linear to oblanceolate or elliptical, acute or obtuse, entire or nearly so, minutely puberulent or glabrate, 1–6 cm. long, 2–10 mm. broad, sessile or narrowed to petioles as much as 7 mm. long; rachis of the inflorescence erect, elongated or sometimes strongly congested; buds erect; hypanthium 1–11 mm. long, sometimes conspicuously colored within, the ring of hairs near the middle; sepals lanceolate, 5–15 mm. long, 2–5 mm. broad, puberulent, reflexed in pairs or individually; petals obovate to fan-shaped, entire or erose on the upper margin, 7–25 mm. long, lavender to blue or dark reddish-purple, unspotted; stamens 8; stigma 4-lobed; style at maturity shorter than or exceeding the stamens; ovary 7–15 mm. long, 8-

ribbed, sessile or essentially so, puberulent with short upwardly appressed hairs; mature capsule 4-sided, 1–4 cm long, 1–3 mm. broad, straight or curved, the beak less than 3 mm. long; seeds brown, sometimes mottled, 1–1.5 mm. long, scaly, the crest less than 0.1 mm. long.

Type.—Based on *Oenothera tenella* Cav. "habitat prope urbem Talcahuano in Chili." No type specimen examined but the original description and illustration leave no doubt as to the species intended.

Oenothera tenella Cav., Icon. 4: 66, t. 396, f. 2. 1797. *Godetia tenella* Steud., Nom. ed. II, 1: 697. 1842. *Godetia cavanillesii* Spach, Hist. Veg. Phan. 4: 391. 1835. *Oenothera auricula* var. *tenella* Lév., Monog. Onoth 270. 1908. *Godetia quadrivulnera* var. *tenella* Jeps., Fl. W. Mid. Calif. 334. 1901.

Oenothera tenuifolia Cav., Icon. 4: 67, t. 397. 1797. Placed in synonomy on the basis of description and illustration. Type locality near the cities of Coquimbo and La Serena, Chile. *Godetia tenuifolia* Spach, Nouv. Ann. Mus. Par. 4: 390. 1835. *Oenothera tenella* var. *tenuifolia* Lindl., Bot. Reg. 19: t. 1587. 1833. *Godetia gayana* Spach, Nouv. Ann. Mus. Par. 4: 391. 1835 (based on *Oe. tenella* var. *tenuifolia* Lindl.). *Oenothera gayana* Steud., Nom. ed. II 2: 206. 1841. *Oenothera prismatica* var. *tenuifolia* Lév., Monog. Onoth. 265. 1908.

Godetia dasycarpa Phil., Linnaea 30: 187. 1859. Type: Valdivia, San Juan, *Philippi*. Photograph of the type (Pomona) examined. *Godetia tenella* var. *dasycarpa* Munz, La Farmacia Chilena (reprint, p. 7) 1934. *Oenothera prismatica* var. *dasycarpa* Lév., Monog. Onoth. 265. 1908. *Oenothera quadrivulnera* var. *dasycarpa* Thell. *ex* Probst., Mitteil Naturfor. Gesellsch. Solothurn 6: 39. 1920.

Godetia ambigua Phil. Anal. Univ. Chili 2: 327. 1865. Type: Chillan, Man. Ant. de Solis, *Philippi*. Photograph of the type (Pomona) examined.

Godetia sulfurea Phil. Anal. Univ. Chili 45: 712. 1872. Type: Valdivia, Pampa Negron, *Philippi*. Photograph of the type (Pomona) examined. *Oenotheridium sulphureum* Reiche, Anal. Univ. Chile 98: 474. 1897.

Godetia cavanillesii var. *atrosanguinea* Phil. & Griseb. *in herb.* *Godetia tenella* f. *atrosanguinea* Munz, Farmacia Chilena (reprint, p. 7). 1934.

Distribution (see fig. 10).—ARGENTINA. Chubut, Neuquen, and Rio Negro. CHILE. Aconcagua, Biobio, Cautin, Colchagua, Concepcion, Coquimbo, Curico, Linares, Malleco, Nuble, O'Higgins, Santiago, Talca, Valdivia, and Valparaiso.

Representative specimens.—ARGENTINA. Chubut: Cordillera del Chubut, Rio Corcavado, *Illin 54*. Neuquen: Lago Trapil, *Cabrera 5093*. Rio Negro: Rio Limay, Gobernacio Rio Negro below Lago Nahuel Huapi, *West 4760*. San Carlos de Bariloche, Nahuel Huapi, *Buchtien 31*. Bariloche Gobernacion del Rio Negro region. Montanosa Cercana al Lago Nahuel Huapi, *Parodi 11413*. CHILE. Aconcagua: Limache, Cerro Cruz, *Looser 2284;* Valle de Marga Marga, *Jaffuel & Pirion 3142*. Colchagua: Puente de Cimbra, Rio Tinguiririca, *Looser 1094*. Concepcion: Near Salto del Laja, *West 5096;* Talcahuano, *Skottsberg 14555*. Coquimbo: Depto. Illapel, Cuesta de Cavilolen, road Illapel to Los Vilos, *Worth & Morrison 16480;* 15 km. north of La Serena on La Serena Road, *Worth & Morrison 16278*. Curico: Hacienda Monte Grande, *Werdermann 508*. Santiago: Santiago, *Claude Joseph 975;* Hacienda Chacahuco, *Looser 2294*. Valparaiso: Renaca, 18 km. from Valparaiso, *Morrison 16838;* Viña del Mar, *West 3960*.

Clarkia tenella is a tetraploid complex in which we have tentatively included all of the diverse assemblage from South America. The morphological extremes are as distinct as many of the diploid species in Section Godetia. These extremes, however, are connected by a complete series of intermediate forms, such that it seems impractical to give formal recognition to any of the variants without additional study of this complex in the wild and in the experimental garden. The form which most closely matches the original description is widespread and occurs throughout the entire area of distribution. The petals in this form are mostly less than a centimeter long, the stigma is not held above the stamens, and it is probably self-pollinated. Among these self-pollinating forms, different populations may apparently differ conspicuously in many characters, including pubescence, flower color, and leaf size and

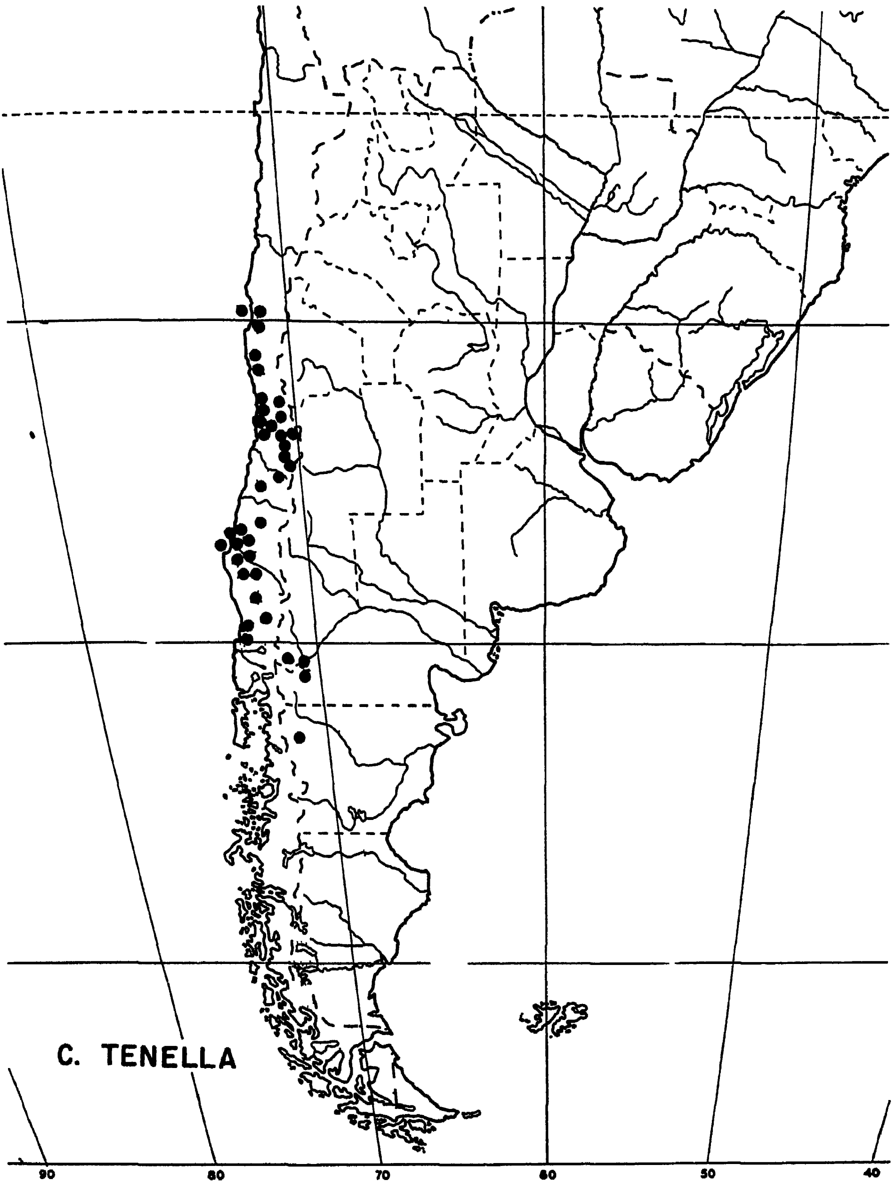


Fig 10 Distribution of *Clarkia tenella.*

conformation. They are in every way comparable to the self-pollinating races of the hexaploid complex, *C. purpurea*, of North America. The small-flowered races of *C. tenella* normally have very short hypanthiums (less than 3 mm.), but one collection has a hypanthium 5 mm. long (Rio Corcavado, Argentina, *Illin 148*). Larger-flowered, apparently outcrossing races also occur throughout most of the range of the species in Chile and may occur sympatrically with the smaller self-pollinators, but no clear line of demarcation can be drawn between the two extremes. Among the larger-flowered forms, those from the vicinity of Valparaiso have shorter hypanthiums (2–4 mm. long) than those further south in Valdivia (7–10 mm. long).

The haploid chromosome number is 17 (Hiorth, 1941). Determinations were made from cultivated strains "Lavender Gem," "Blauer Zwerg," "dasycarpa," and from progenies grown from seeds collected in the wild, "Chile A and B." We have grown only the cultivated "Lavender Gem."

Relationship.—Clarkia tenella is morphologically most similar to *C. davyi* and *C. purpurea* and is sometimes difficult to distinguish from them as herbarium collections, except by locality. *Clarkia tenella* and *C. davyi* are both tetraploids with a gametic number of 17 chromosomes and may have had a common origin. One might wish to consider them conspecific. *Clarkia tenella*, however, is usually distinguishable from *C. davyi* on the basis of leaf shape and the position of the ring of hairs in the hypanthium. Furthermore, the flower size of *C. tenella* is frequently much greater than in *C. davyi*. We have had no opportunity to cross them, but since they are morphologically distinguishable and are obviously strongly isolated by distance, it seems best to recognize them as distinct species. The relationship between *C. tenella* and the hexaploid species *C. purpurea* may also be very close. On morphological grounds, the tetraploid parent of *C. purpurea* might very well have been one of the forms of *C. tenella*. The two species are remarkably similar in their complex pattern of morphological diversity. They can usually be distinguished, however, by the position of the ring of hairs in the hypanthium. Some of the sheets of *C. tenella* are very similar to the diploid species *C. speciosa*. This suggests that one of the diploid parents of *C. tenella* was probably much like *C. speciosa*, if not actually that species.

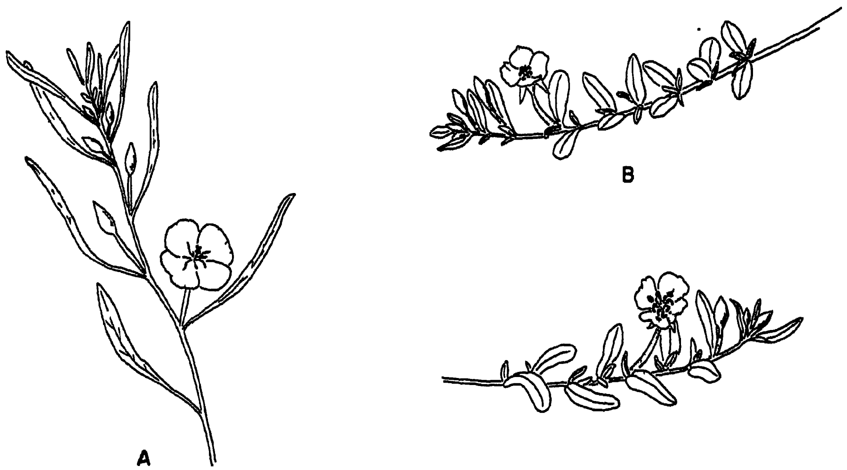


Fig. 11. *a*, *Clarkia tenella*, inflorescence × ½; *b*, *C. davyi*, inflorescence × ½; *c*, *C. prostrata*, inflorescence × ½.

11. **Clarkia davyi** (Jepson) Lewis & Lewis, Madroño 12: 33. 1953.

(Fig. 11, *b*.)

Decumbent to prostrate; stems as much as 7.5 (9) dm. long, simple or branched, sparsely puberulent above with short, upwardly curled hairs, sparsely puberulent to glabrate below; leaves oblanceolate to broadly elliptic or obovate, characteristically obtuse, entire or nearly so, 1–2 (2.5) cm. long, 2–7 mm. broad, glabrate to sparsely puberulent, sessile or nearly so, usually longer than the internodes; rachis of the inflorescence straight; buds erect; hypanthium 2–5 mm. long, not conspicuously colored within, the ring of hairs present in the lower third or obscure; sepals lanceolate, 5-7 mm. long, 1.5–3 mm. broad, sparsely puberulent, reflexed in pairs or sometimes individually at anthesis; petals fan-shaped to obovate, 5–11 mm. long, entire to erose, lavender-pink, the lower fourth or third white or cream, unspotted; stamens 8, yellowish, usually adhering to the mature stigma; stigma 4-lobed, the lobes short, purple to nearly white; mature style shorter than the stamens; ovary puberulent, 9–15 mm. long, sessile or essentially so, strongly 8-ribbed, the grooves usually red; mature capsule 1.5–2.5 cm. long, 2–3 mm. broad; seeds brown or grayish, scaly, about 1 mm. long, the crest minute or obscure.

Type.—Based on the type of *Godetia quadrivulnera* var. *davyi* Jepson. Point Reyes, Sonoma County, California, *Davy 6701*, June 18, 1900 (Jepson Herbarium).

Godetia quadrivulnera var. *davyi* Jeps., U.C. Publ. Bot. 2: 341. 1907.

Distribution (see fig. 7).—CALIFORNIA. Del Norte, Humboldt, Marin, Mendocino, San Francisco, San Mateo, and Sonoma counties. On sea bluffs or near the coast.

Representative specimens.—CALIFORNIA. Humboldt County: sand dunes of Ocean Beach at Humboldt Bay, *Tracy 2592.* Marin County: Point Reyes Post Office, *Elmer 4610;* 4 miles from Point Reyes Lighthouse, *Ferris & Wiggins 8120;* Point Reyes between Drakes Estero and the Pacific Ocean, *Keck 4573.* San Mateo County: near Ocean View, San Francisco, *Heller 8384.*

Progenies from the following localities have been studied in the experimental garden. Marin County: 5.8 miles northwest of Point Reyes Lighthouse, *439.* Mendocino County: Highway 1, across the bay from Caspar, *429;* Highway 1, 4.6 miles north of Manchester School, *431;* Highway 1, 3.9 miles north of road to Plantation, 14.5 miles north of Fort Ross Historical Monument, *433.*

The haploid chromosome number is 17, based upon root-tip counts of three plants from colony *433.*

Clarkia davyi is ecologically restricted and morphologically quite uniform. It is ordinarily self-pollinated, which probably accounts for the morphological uniformity within populations. Differences between colonies are apparent, however. For example, population *431* had nearly white stigmas, and those of *429* and *433* were lavender. The population at Ocean View Station just south of Lake Merced, San Francisco, is not typical of *C. davyi.* Many of the plants grow erect and have leaves which suggest that hybridization with *C. purpurea* may have occurred in this area. However, the hybrid between these two species is quite sterile and difficult to produce in the garden.

Relationship.—*Clarkia davyi* is morphologically very similar to some forms of *C. tenella,* and these two species may well represent segregates from a common tetraploid ancestor. Crosses between them have not yet been made. *Clarkia davyi* is also very similar to *C. prostrata,* both morphologically and ecologically, but they replace each other geographically. The latter is hexaploid and most surely has *C. davyi* as its tetraploid parent. (See *C. prostrata.*) They can be distinguished by the smaller, unspotted flowers of *C. davyi.* The flowers and capsules of *C. davyi* closely resemble those of some forms of *C. purpurea quadrivulnera,* but these two taxa differ conspicuously in habit and the latter is hexaploid.

12. **Clarkia prostrata** Lewis and Lewis, Madroño 12: 36. 1953. (Fig. 11, *c.*)

Prostrate or decumbent herbs; stems as much as 5 dm. long, simple or divaricately branched, sparsely puberulent above with short, upwardly curled hairs, sparsely puberulent to glabrate below; leaf blades oblanceolate to elliptic, 1–2.5 cm. long, 4–8 mm. broad, entire or nearly so, the apex usually obtuse, glabrate to sparsely puberulent, sessile or nearly so; rachis of the inflorescence straight, the buds erect; hypanthium 4–7 mm. long, sometimes pink on the outside, not conspicuously colored within, the ring of hairs in the lower third; sepals lanceolate, 6–8 mm. long, 2–3 mm. broad, puberulent, usually reflexed in pairs; petals fan-shaped to truncate-obovate, entire to erose or emarginate, 10–15 mm. long, lavender-pink shading to cream or yellowish below, usually with a deltoid blotch of bright reddish-purple at the base of the lavender-pink; stamens 8; anthers cream; pollen cream; filaments greenish; stigma 4-lobed, the lobes short, lavender-purple to pale lavender; mature style equaling the shorter stamens; ovary puberulent, 10–18 mm. long, strongly 8-ribbed, sessile or essentially so; mature capsule quadrangular, 2–3 cm. long, 2.5–3 mm. broad; seeds brown or grayish, scaly, 1–1 5 mm. long, the crest less than 0.2 mm. long.

Type.—State Highway 1, 1.3 miles north of Pico Creek Bridge, between San Simeon and Cambria, San Luis Obispo County, California, June 10, 1950, *Lewis & Lewis 712* (U.C.L.A.).

Distribution (see fig. 7).—CALIFORNIA. Monterey, San Luis Obispo, and Santa Cruz counties, and on Santa Rosa Island, Santa Barbara County. Sea bluffs.

Specimens examined.—CALIFORNIA. Monterey County: Monterey, *Abbott* in 1904, *Guirado 638;* Pacific Grove, *Patterson & Wiltz* in 1907. San Luis Obispo County: State Highway 1, 0.5 mile south of San Carpoforo Creek Bridge, *Lewis & Lewis 714;* Piedras Blancas, *Eastwood & Howell 5983;* State Highway 1, 0.5 mile north of Piedras Blancas, *Lewis & Lewis 713;* 1 mile north of the mouth of Pico Creek (2.5 miles south of San Simeon), *Keck & Hiesey 5150;* San Simeon Bay near Cambria, *Eastwood 15148;* between Cambria and San Simeon, *Eastwood & Howell 5973;* Cambria, *Winblad* in 1937; *Eastwood & Howell 5943; Lewis & Lewis 711;* Morro Bay, *Condit* in 1911. Santa Barbara County: Santa Rosa Island, Water Canyon, *Hoffman 692;* Santa Rosa Island, *Dunn* in 1932; *Youngberg* in 1938; *Hoffman* in 1930. Santa Cruz County: Santa Cruz, *M. E. Jones* in 1881.

Progenies from the following localities have been studied in the experimental garden. San Luis Obispo County: Piedras Blances Point, *169;* Cambria, corner of York Street and Highway 1, *711;* Highway 1, 0.5 mile south of San Carpoforo Creek Bridge, *714.*

The haploid chromosome number is 26, determined from microsporocytes of a plant from each of the populations *169* and *712* (type collection).

The populations grown in the garden have been very uniform. We have noted minor variations, however, in wild populations with respect to color intensity of the flowers and the expression of the spot. We have not seen living material of the Santa Rosa Island populations which have somewhat smaller flowers and leaves. In these respects, they resemble *C. davyi* and may possibly represent this species.

Relationship.—*Clarkia prostrata* is an allohexaploid species, which on morphological and ecological grounds, as well as chromosome number, has probably been derived from *C. davyi* (n = 17) and *C. speciosa* (n = 9). *Clarkia prostrata* and *C. davyi* are both found on the sea bluffs in very similar ecological situations, although the distribution of the former is farther south. Morphologically, *C. prostrata* is very close to *C. davyi* but differs from it in the direction of *C. speciosa.* For example, the flowers of *C. prostrata* are intermediate in size between those of *C. davyi* and *C. speciosa* and have a petal spot which is characteristic of the latter species but is absent in *C. davyi.* The hybrid between *C. davyi* and *C. speciosa* is morphologically equivalent to *C. prostrata* and the hexaploid derivative of this hybrid sets an abundance of good seed when crossed with *C. prostrata.* The relationship between *C. prostrata* and *C. purpurea*, the other hexaploid species in Section Godetia, does not seem to be a direct one. The hybrid between them is only partly fertile and meiosis is irregular. For example, in one hybrid (*C. purpurea, 23* × *C. prostrata, 169*) one microsporocyte had 16 pairs, 3 chains of 3, and 11 unpaired chromosomes at meiotic first metaphase, whereas another had 12 pairs, 5 chains of 3, and 13 unpaired chromosomes. Furthermore, several of the pairs were conspicuously unequal.

13. **Clarkia purpurea** (Curtis) Nelson & Macbride, Bot. Gaz. 65: 64. 1918.

(Fig. 12, *a, b, c, d.*)

Erect or decumbent herbs as much as 7.5 (10) dm. tall; stems simple or branched, glabrous to densely puberulent above with short, upwardly curled hairs, sometimes with additional longer spreading or curled hairs, glabrous or sparsely puberulent below; leaves linear to narrowly oblanceolate, sometimes elliptic or ovate, 2–7 cm. long, 2–5 or as much as 12 mm. broad, entire or nearly so, densely puberulent to essentially glabrous, sometimes glaucous, sessile or on petioles less than 2 mm. long; rachis of the inflorescence erect, elongated or strongly congested; buds erect; hypanthium 2–10 mm. long, often conspicuously colored within, the ring of hairs in the lower third; sepals lanceolate, 6–15 mm. long, 1–3.5 mm. broad, puberulent, sometimes with additional longer-curled hairs or glabrous, usually reflexed individually or in pairs at anthesis; petals fan-shaped, obovate or elliptic, rarely rhomboid, entire to erose, apiculate to emarginate, 5–25 mm. long, lavender or pale pink, rarely white, to purple or deep wine red, with or without a red or purple spot at or near the apex, in the middle, or at the base, sometimes spotted both at the base and above; stamens 8, pale cream to lavender or dark reddish-purple, often the inner or outer series adhering to the mature stigma; stigma subglobose or 4-lobed, the lobes rounded to linear, white, pink or purple; style at maturity shorter than or exceeding the stamens; ovary 8–15 mm. long, prominently 8-ribbed, sessile or essentially so, glabrate to puberulent or densely pubescent with long spreading or curled hairs, occasionally stellate-pubescent; immature capsule less than 8 times as long as broad before drying; mature capsule quadrangular, 1–2 (3) cm. long, 2–4 mm. broad, straight or essentially so, abruptly rounded at the base, sometimes with a beak as much as 2 mm. long; seeds brown or grayish, scaly, 1–2 mm. long, the crest as much as 0.2 mm. long.

Type.—Based on the type of *Oenothera purpurea* Curtis.

This species was described and illustrated from plants grown at Kew from seeds introduced from the western coast of North America. No specimen could be found at Kew which can be considered the type. The illustration leaves no doubt, however, as to the species intended and is taken as the type. This illustration represents a form of *C. purpurea* which is but rarely encountered. The stems are apparently glabrous, or at least glabrate, and the leaves are broad, ovate, and glaucous. The purple flow-

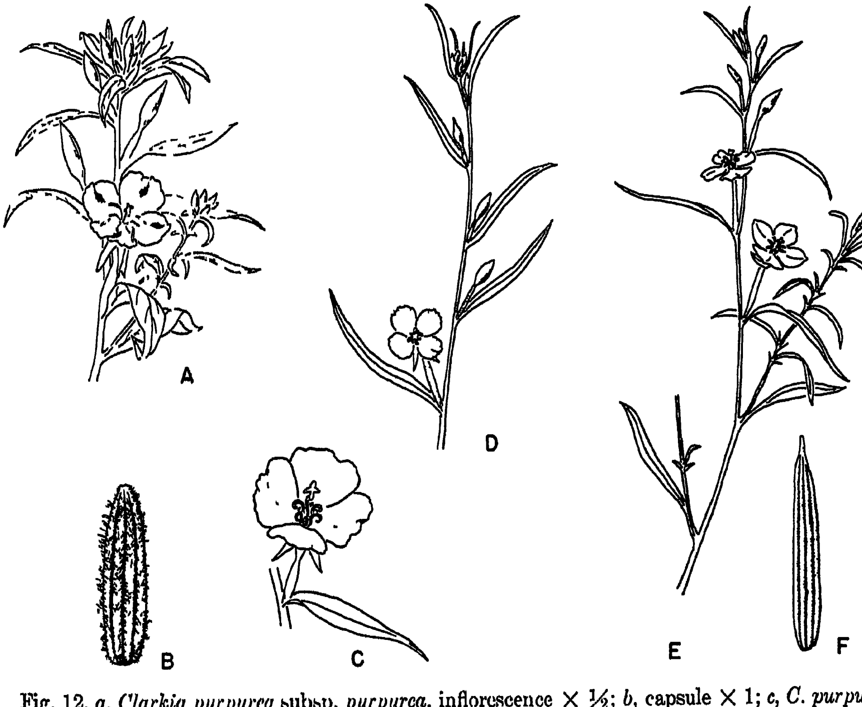


Fig. 12. *a*, *Clarkia purpurea* subsp. *purpurea*, inflorescence × ½; *b*, capsule × 1; *c*, *C. purpurea* subsp. *viminea*, flower × 1½; *d*, *C. purpurea* subsp. *quadrivulnera*, inflorescence × ½; *e*, *C. affinis*,

ers are congested and the stigma is shown as being well exserted, suggesting that the plant is normally outcrossed. A close match for this illustration is found in a sheet labeled "*Oe. purpurea*—California, Hinds" in the Lindley Herbarium. The original seed collection may have come from the vicinity of San Francisco Bay.

A very large and diverse assemblage of morphological forms is included in *Clarkia purpurea* in the present treatment. In a sense, it represents the residue after the other demonstrably valid species of Section Godetia have been set aside. The entire assemblage is allohexaploid so far as is known and may or may not have had a single origin. The morphological diversity may in part have resulted from repeated formation of an allohexaploid. For example, a genome of a tetraploid species may have combined at different times with various related diploid genomes. The resulting allohexaploids would be morphologically diverse, but at the same time similar, and might well be interfertile. On the other hand, an alloploid of a single origin might become greatly diversified as a consequence of exchange between the genomes of the contributing species after the alloploid was formed. Or, an alloploid species might become differentiated as a result of backcrossing to the original parents. Once a diverse group of closely related alloploid races or species is established, further variation can result from hybridization between them. The story behind the variable assemblage we have called *C. purpurea* is far from being understood. Morphologically very different local races of *C. purpurea* may have genomes which pair regularly at meiosis in their hybrids, or a hybrid may form a few chains or rings or show a few unpaired chromosomes, which indicates that the two races are either of different origin or that they have differentiated chromosomally since their common origin. The number of hybrids examined has been small, but there has been no direct correlation between similarity of genomes as indicated by meiotic behavior and morphological similarity.

The most diverse forms have often proved to be completely interfertile, and yet they may occur sympatrically. Several factors may account for their sympatric distribution, but perhaps the most important is self-pollination. Selective pollination by insects may also be important. We have collected open pollinated seeds in nature from sympatric and potentially interfertile morphological races and have grown them in the experimental garden. Such progenies have almost invariably come true to the parental type. But these distinct local races may be ephemeral inasmuch as hybridization apparently does occur at least occasionally. As a result, new adapted genotypes may replace one or both of the original parental strains. To attempt to describe this vast array of local and, in some cases, perhaps, ephemeral races would be an endless and, we suspect, a useless task. Nevertheless, it may be convenient to designate by name the most conspicuous morphological expressions. These are designated here as subspecies, although they are neither geographical nor ecological races as these terms are ordinarily employed. They are at least in part artificial categories, designed for more ready reference to particular morphological expressions. Intermediates between the morphological modes described are frequent.

KEY TO THE SUBSPECIES

A. Leaves broadly lanceolate to elliptic or ovate, usually less than 5 times as long as broad; flowers congested.. ....13*a*. subsp. *purpurea*

AA. Leaves linear to narrowly lanceolate, more than 6 times as long as broad; flowers lax or congested.

B. Petals 15-25 mm. long; stamens shorter than the mature stigma, free; anthers maturing earlier than the stigma.. . . . . .13*b*. subsp. *viminea*

BB. Petals less than 15 mm. long; stamens equaling the stigma, and adhering to it; anthers and stigma maturing simultaneously... . ...13*c*. subsp. *quadrivulnera*

13*a*. C. **purpurea** subsp. **purpurea**. (Fig. 12, *a*, *b*.)

Stem erect, glabrous, and often white-shining below, puberulent above; leaves broadly lanceolate to elliptical or ovate, 15-45 mm. long, 5-20 mm. broad, usually less than 5 times as long as broad, glabrate to puberulent; inflorescence congested; petals 10-25 mm. long, lavender to purple or purplish-red, often with a darker spot near the apex: stigma subglobose or conspicuously lobed, at maturity equaling or held above the stamens; ovary much longer than the internode above.

Oenothera purpurea Curtis, Bot. Mag. 10: t. 352. 1796. *Godetia willdenowiana* Spach, Hist. Veg. Phan. 4: 388. 1835. *Godetia purpurea* Don, in Sweet, Hort. Brit. ed. III, 237. 1839.

Godetia purpurea var. *lacunora* Jeps., U.C. Publ. Bot. 2: 346. 1907. Type: Oakdale, Stanislaus County, California, *Jepson*, July 1, 1896 (Jepson Herbarium). This collection was later numbered *13334* then changed to *14374* but still later restored to *13334* as it now appears on the type. Jepson cites this collection as *14374* in his Flora (2: 582). *Godetia purpurea* var. *lacunarum* Jeps., Man. Fl. Pl. Calif. 679. 1925.

Godetia purpurea var. *elmeri* Jeps., U.C. Publ. Bot. 2: 345. 1907. Type: Santa Barbara, California, *Elmer 3791*, May 1902 (Jepson Herbarium). This specimen is intermediate between *C. purpurea* subsp. *purpurea* and subsp. *quadrivulnera*.

Distribution (see fig. 13). CALIFORNIA: Lowlands in Marin, Monterey, San Luis Obispo, Placer, Santa Barbara, Solano, and Stanislaus counties. OREGON: Douglas County.

Specimens examined. CALIFORNIA. Marin County: Sausalito, *Eastwood 13913;* Tomales Point, *Newell* in 1905; Tiburon, *Walker 1736*. Monterey County: Pescadero, *Brewer 690*. Placer County: U.S. Highway 99E, 1 mile north of Lincoln, *Heller 16121; Wolf 8613;* 2 miles north of Lincoln, *Constance 2821;* between Lincoln and Sheridan, *Eastwood 10593*, Sacramento Valley just above Lincoln, *Hall 10291*. San Luis Obispo County: dunes north of Guadalupe, *Lewis & Epling 180*. Santa Barbara County: Pt. Sal, *Hoffman* in 1931; 3.9 miles south of Santa Maria, *Lewis & Epling 39*. Solano County: Elmira, *Brandegee 121, 122; C. F. Baker 2902;* Harley's, *C. F. Baker 2884;* Little Oak, *Jepson* in 1890. Stanislaus County: Oakdale, *Jepson 13334* (*14374*). OREGON. Douglas County: Roseburg, Umpqua Valley, *Howell* in 1887.

The collections listed are those which come the closest to the original illustration and description. These collections are infrequent and for the most part widely separated. This may be due to any one of several reasons: the interpretation of the herbarium material may be faulty; the various populations may represent independent segregates of an extreme type in diverse parts of the range of the *C. purpurea* complex; or, they may represent remnants of a once wider distribution. The last possibility is not remote. In general appearance, these plants seem to be adapted to rather moist situations as compared to closely related forms. It is at least possible that plants corresponding to the type of *C. purpurea* were at one time frequent or abundant in the lowland areas, which proved most suitable for cultivation. This particular form may, consequently, be much more restricted at present than it was a century ago.

Progenies from Santa Maria (*39*) have been studied in the experimental garden. These have been quite uniform except for flower color. However, the congested inflorescence which is characteristic of the wild population largely disappears under cultivation.

Populations morphologically intermediate between subspecies *purpurea* and *quadrivulnera* are frequent in California (e.g., Butte County: 4.5 miles north and 1.5 miles east of Biggs, *Embree 43*. Santa Barbara County: Arroyo Grande Hills, *Sum-*

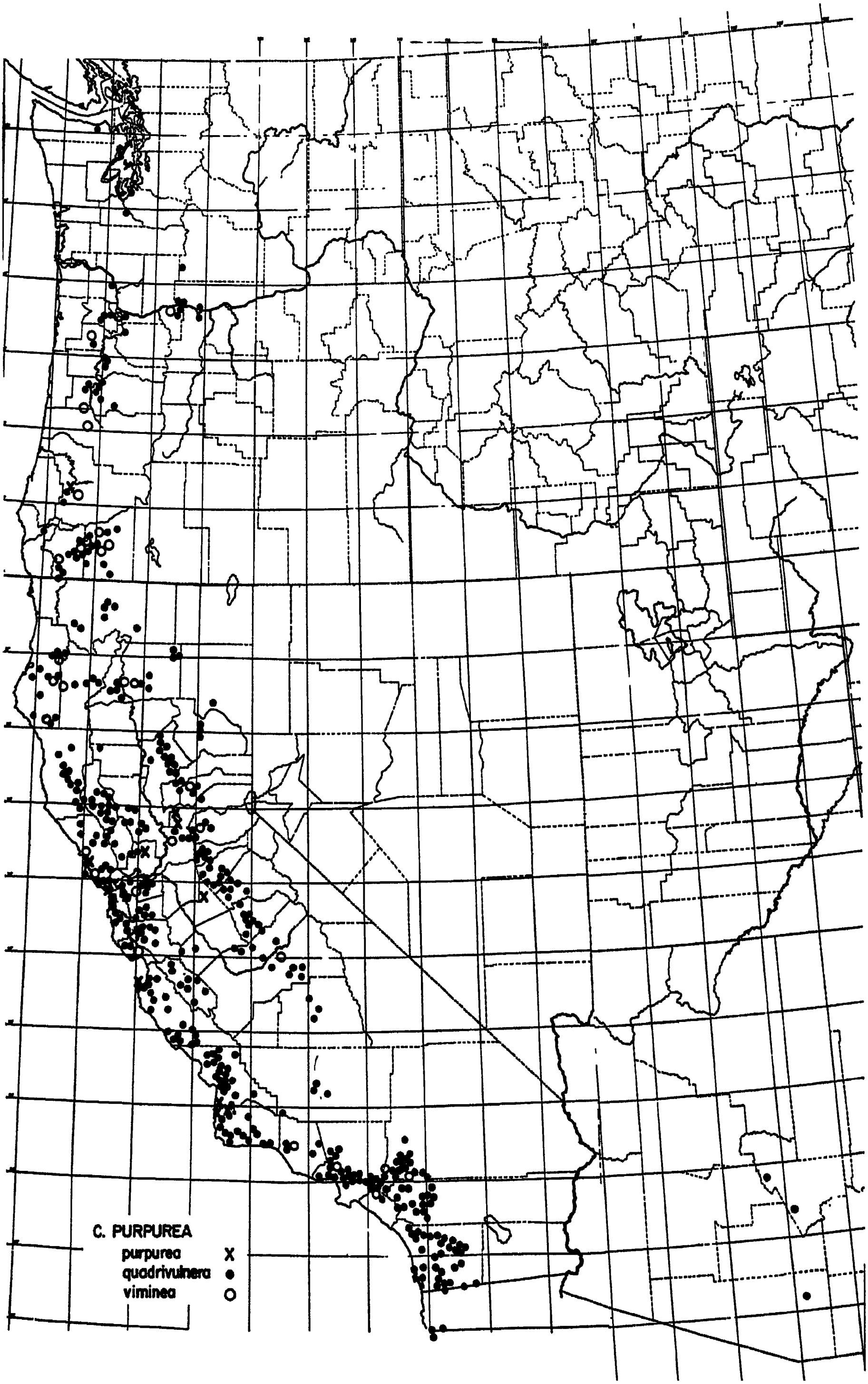


Fig. 13. Distribution of *Clarkia purpurea*.

mers in 1886; Santa Margarita Valley, *Summers* in 1882; Santa Maria near boundary between San Luis Obispo and Santa Barbara County, *Eastwood* in 1896. San Diego County: Cuyamaca Lake, *Brandegee* in 1906). Populations intermediate between subspecies *purpurea* and subspecies *viminea* also occur (e.g., California, Yolo County: Cache Creek Canyon, *C. F. Baker 5065;* Oregon, Benton County: Monroe, *Munz 9900*).

The horticultural form grown as *Godetia purpurea* by Hiorth (1941), and examined cytologically by Håkansson (1941*b*), is apparently intermediate between *C. purpurea purpurea* and *C. purpurea quadrivulnera*. *Godetia purpurea* of these authors from Glen Ellen, Sonoma County, California, is referable to *C. purpurea quadrivulnera* on the basis of the photograph shown by Hiorth (1941).

13*b*. **Clarkia purpurea** subsp. **viminea** (Douglas) Lewis & Lewis comb. nov. (Fig. 12, *c*.)

Stems erect or decumbent, puberulent at least above with short, upwardly curled hairs; leaves linear to narrowly lanceolate, 3–7 cm. long, 2-8 mm. broad, at least 6 times as long as broad, puberulent; inflorescence lax, not strongly congested; petals 15–25 mm. long, lavender to purple, usually with a darker wedge- or shield-shaped spot near the apex, sometimes darker near the base; stigma 4-lobed, the lobes 1–2 mm. long, held above the recurved anthers, maturing after the pollen is shed.

Type.— Based on the type of *Oenothera viminea* Doug. "interior of northern California" (= Umpqua River, Oregon), *Douglas* (Kew).

Oenothera viminea Doug, Hook. Bot. Mag. 55: t. 2873. 1828. *Godetia viminea* Spach, Hist. Veg. Phan. 4: 389. 1835. *Oenothera prismatica* var. *viminea* Lév., Monog Onoth. 265. 1908. *Clarkia viminea* Nels. & Macbr., Bot. Gaz. 65: 61 1918.

Godetia lepida Lindl, Bot. Reg. 22: 1849. 1836. Type: California, *Douglas* (Lindley Herbarium). *Oenothera lepida* Dietr., Syn. Pl. 2: 1287. 1840. *Oenothera lepida* Hook. & Arn., Bot. Beech. Voy. 342. 1840.

Oenothera arnottii T. & G., Fl. N. Am. 1: 503. 1840. Type: California, *Douglas* (Kew). *Godetia arnottii* Walp., Rep. 2: 88. 1843. *Oenothera lepida* var. *arnottii* Wats., Proc. Am. Acad. 8: 597. 1873. *Godetia lepida* var. *arnottii* Wats, Bot. Cal. 1: 229. 1876. *Clarkia arnottii* Nels. & Macbr, Bot. Gaz. 65: 61. 1918.

Godetia goddardii Jeps., U.C. Publ. Bot. 2: 342. 1907. Type: Hupa wagon trail near Redwood Creek, Humboldt County, California, *Jepson 1971* (Jepson Herbarium).

Godetia quadrivulnera f. *setchelliana* Jeps., U.C. Publ. Bot. 2: 341. 1907. Type: Soquel Canyon, Santa Cruz Mountains, California, *Setchell & Jepson*, June 20, 1896, later numbered *13335*. Setchell's name does not appear on the type specimen (Jepson Herbarium). *Godetia quadrivulnera* var. *setchelliana* Jeps., Man. Fl Pl. Calif. 678. 1925.

Oenothera viminea var. *intermedia* Kellogg, Proc. Cal Acad. 1: 61. 1854 Type: Alameda, *T. J. Nevins*. The type specimen can not be found, presumably destroyed in 1906. Placed in synonomy on basis of description.

Oenothera auricula var. *tenella* subvar. *williamsonii* f. *vimineiformis* Lév., Monog. Onoth. 272. 1908. Type: Umpqua Valley, Oregon, *Howell 1144*, June 18, 1887. Type not examined. Placed in synonomy on basis of description.

Distribution (see fig. 13).—CALIFORNIA. Contra Costa, Eldorado, Fresno, Humboldt, Los Angeles, Marin, Nevada, Orange, Sacramento, San Bernardino, Santa Clara, Santa Cruz, Shasta, Sonoma, Trinity, and Ventura counties. OREGON. Benton, Douglas, Jackson, Josephine, Hood River, Lane, Multnomah, Polk, and Yamhill counties. Open sites in woodland or chaparral.

Representative specimens. CALIFORNIA. Contra Costa County. North Road, 2 miles from North Gate, Mt. Diablo, *Bowerman 2938*. Eldorado County: hillside above Smithflat, *Robbins 1970*. Fresno County: summit of Black Mountain, *Bullard 27*. Humboldt County: hills west of the South Fork of the Trinity River near its mouth, *Tracy 14924;* Dinsmore's Ranch, opposite Buck Mountain, *Tracy 3957*. Marin County: Olema, *Walker 1199*. San Bernardino County: Cucamonga Canyon, *Williams* in 1905. Santa Clara County: foothills west of Los Gatos, *Heller 7446;* 4 miles south of Saratoga, *Pendleton 173;* hillside west of Raymonds, *Dudley* in 1906. Santa Cruz County: summit, 3 miles from Big Basin toward Boulder Creek, *Randall* in 1930. Shasta County: Ingot, *Applegate 5836;* Pitt to Baird, *Eastwood 1405.* Sonoma County: Monte Rio, *Hoak* in 1912. OREGON. Jackson County: 6 miles west of Trail, *Hitchcock & Martin 5075;* Eagle Point on lower part of Antelope Creek, *Applegate 2322.* Josephine County: Grants Pass, *Prescott* in 1912; *Henderson 356.* Hood River County: Minomince, *Suksdorf 749.* Yamhill County: McMinnville, *Shear 5621;* North Yamhill, *Henderson* in 1882.

Progenies from the following localities have been studied in the experimental garden. CALIFORNIA. Humboldt County: Highway 36, 0.1 mile west of the Trinity-Humboldt county line, *415.* Los Angeles County: Santa Monica Mountains, Sepulveda Boulevard at North Sepulveda Way, *29.* Marin County: 1.9 miles south of Olema on road to San Rafael, *440.* Nevada County: Highway 20, 1.3 miles north of junction with Highway 49, *60.* San Bernardino County: Sand Canyon, between Redlands and Yucaipa, *53.* Santa Cruz County: 3.7 miles northwest of Boulder Creek P. O. on road to Big Basin, *500.*

The populations that have been included in this subspecies are heterogeneous with respect to habit, foliar characteristics, pubescence, flower color, and color pattern. Each population that we have grown has been unique. However, they all have relatively large, protandrous flowers with elongated styles and are primarily outcrossed. But numerous intermediates between these populations and the self-pollinating strains of subspecies *quadrivulnera* occur. Individuals of these two taxa, which may be contrastingly different in many morphological characters, nevertheless may produce fertile hybrids. Some of the contrasting characters segregate as simple alleles, others are obviously determined by polygenic systems. For example, a small-flowered (1 cm. across), self-pollinated strain of subspecies *quadrivulnera* with dark wine-red petals crossed with a large-flowered (5 cm. across) individual of subspecies *viminea* with lavender petals and an apical purple spot gave an F_1 with dark wine-red petals and flowers 3 or 4 cm. across. An F_2 of several hundred plants produced a continuous spectrum of variation with respect to flower size but sharp segregation for flower color. The number of individuals with dark wine-red petals were in great excess. Some collections suggest that hybridization of this sort has recently occurred in nature (e.g., California, Orange County: Santiago Peak Trail, *Abrams 1796.* Riverside County: Elsinore, *Hyde* in 1935. Ventura County: Sulphur Mountain, *Abrams & McGregor 45*). Intermediates between subspecies *viminea* and subspecies *purpurea* are not so frequent as between subspecies *viminea* and subspecies *quadrivulnera*, but apparent morphological intermediates are found, as was indicated above. These have rather broad leaves and a somewhat congested inflorescence but are otherwise typical of subspecies *viminea*. The type specimen of *Oe. arnottii* T. & G. represents such an intermediate.

The haploid chromosome number is 26, based upon examination of microsporocytes and root tips of five individuals from populations *440* and *500.* No meiotic irregularities were observed. Interpopulational hybrids, however, may show irregularities. For example, in a hybrid between two populations of subspecies *viminea* (*60* and *29*) three microsporocytes were completely analysed. These showed 26 pairs in one cell, 24 pairs, plus 1 chain of 3 and 1 unpaired chromosome in another, and 23 pairs, plus 2 chains of 3 in a third cell. Another hybrid (*53* × *60*) had microsporocytes which indicated a somewhat greater chromosomal differentiation between the two populations. The most irregular cell showed 19 pairs, 2 rings of 4, 1 chain of 3, and 3 unpaired chromosomes. Nevertheless, the hybrid was highly fertile. A hybrid between subspecies *viminea* (*29*) and subspecies *quadrivulnera* (*45*) had an extra chromosome. This extra chromosome was sometimes unpaired, at other times formed part of a trivalent.

The plants grown by Hiorth (1941) as *G. "quadrivulnera"* from Placerville, California, are probably best referred to subspecies *viminea*. These plants had n = 26 (Håkansson, 1941*b*). The plants grown by Chittenden (1928) as *G. lepida* (n = 26) are also probably referable to this subspecies to judge from the size of the flowers.

13*c*. **Clarkia purpurea** subsp. **quadrivulnera** (Douglas) Lewis & Lewis comb. nov. (Fig. 12, *d*.)

Stems erect, puberulent at least above, with short, upwardly curled hairs; leaves linear to lanceolate, 15–50 mm. long, 1.5–6 mm. broad, sometimes broader, puberulent to glabrate; inflorescence lax or strongly congested; petals less than 15 mm. long, usually about 10 mm. long, lavender to purple or often a deep wine red, the lighter flowers often with a wedge- or shield-shaped spot of purple at the apex or near the middle, sometimes darker near the base; stigma subglobose or the lobes short, maturing with the stamens and not held above them; anthers usually adhering to the stigma and depositing pollen directly upon it.

Type. - Based on the type of *Oenothera quadrivulnera* Douglas. Northwest of North America, *Douglas* (Lindley Herbarium).

Oenothera quadrivulnera Doug. *in* Lindl., Bot. Reg. 13: t. 1119. 1828. *Godetia quadrivulnera* Spach, Hist. Veg. Phan. 4: 389. 1835. *Oenothera prismatica* var. *quadrivulnera* Lév., Monog. Onoth. 267. 1908. *Clarkia quadrivulnera* Nels. & Macbr., Bot. Gaz. 65: 63. 1918.

Oenothera quadrivulnera var. *hirsuta* Kellogg, Proc. Cal. Acad. 5: 45. 1873. Type: Petaluma, Sonoma County, California, *Harford*, June 7, 1870. No type specimen can be found, presumably destroyed in 1906. Placed in synonomy on basis of description.

Godetia quadrivulnera f. *flagellata* Jeps., U.C. Publ. Bot. 2: 341. 1907. Type: Vaca Mountains, California, *Jepson*, June 12, 1893, later numbered *13340* (Jepson Herbarium). *Godetia quadrivulnera* var. *flagellata* Jeps., Man. Fl. Pl. Calif. 678. 1925.

Godetia quadrivulnera var. *apiculata* Jeps., U.C. Publ. Bot. 2: 341. 1907. Type: Howell Mountain, California, *Jepson 2441* (Jepson Herbarium).

Godetia quadrivulnera var. *hallii* Jeps., U.C. Publ. Bot. 2: 341. 1907. Type: eastern base of Box Springs Mountain, Riverside County, California, *Hall 6241*, June 3, 1905, (Jepson Herbarium).

Godetia quadrivulnera var. *rubrissima* Jeps., U.C. Publ. Bot. 2: 341. 1907. Type: eastern base of Box Springs Mountain, Riverside County, California, *Hall 6240*, June 3, 1905 (Jepson Herbarium).

Godetia quadrivulnera var. *vacensis* Jeps., U.C. Publ. Bot. 2: 341. 1907. Type: Vaca Mountains, California, *Jepson*, June 12, 1893, later numbered *14373*. The specimen which on the basis of locality, date, and description is certainly the type (Jepson Herbarium sheet 1944) was altered by Jepson so that it is now numbered *13340* and labeled var. *flagellata*.

Oenothera decumbens Doug., Hook. Bot. Mag. 56: t. 2889. 1829. Type: California, *Douglas* (Kew). *Godetia decumbens* Spach, Hist. Veg. Phan. 4: 288. 1835. *Clarkia decumbens* Nels. & Macbr., Bot. Gaz. 65: 64. 1918. *Oenothera lepida* var. *parviflora* Wats., Proc. Am. Acad. 8: 597. 1873. *Godetia lepida* var. *parviflora* Wats., Bot. Cal. 1: 229. 1876. *Godetia purpurea* var. *parviflora* Hitch., Bot. Gaz. 89: 335. 1930.

Godetia albescens Lindl., Bot. Reg. 27: misc. 61. 1841. Type: Columbia River, *Dyer*. No type specimen can be found. Placed in synonomy on basis of description and illustration in Bot. Reg. 28: t. 9. 1842. *Oenothera albescens* Wats., Proc. Am. Acad. 8: 597. 1873.

Godetia micropetala Greene, Pittonia 1: 32. 1887. Type: hills along Walnut Creek, at the western base of Mt. Diablo, Contra Costa County, California, *Greene*, May 26, 1886 (isotype examined at U.S. Nat. Herb.). *Godetia albescens* var. *micropetala* Jeps., Fl. W. Mid. Cal. 334. 1901.

Godetia bingensis Suksd., Deutsch. Bot. Monat. 18: 88. 1900. Type: Bingen, Klickitat County, Washington, *Suksdorf 86*, July 4, 1892 (U.S. Nat. Herb.).

Godetia lanata Elmer, Bot. Gaz. 61: 317. 1906. Type: Bardins railroad switch, Monterey County, California, *Elmer 4376*, June 1903 (U.S. Nat. Herb.).

Godetia goddardii f. *capitata* Jeps., U.C. Publ. Bot. 2: 342. 1907. Type: Centerville, Fresno County, California, *Jepson 2745* (Jepson Herbarium). *Godetia goddardii* var. *capitata* Jeps., Man. Fl. Pl. Calif. 678. 1925.

Godetia goddardii var. *miguelita* Jeps., U.C. Publ. Bot. 2: 342. 1907. Type: San Miguelito Rancho, San Luis Obispo County, California, *Jepson 1625* (Jepson Herbarium).

Godetia purpurea var. *procera* Jeps., U.C. Publ. Bot. 2: 346. 1907. Type: Berkeley, *Bioletti*, July, 1891 (U.C. Berkeley).

Godetia sparsifolia Jeps., U.C. Publ. Bot. 2: 347. 1907. Type: Tracy, San Joaquin County, California, *Cobb*, April 10, 1900 (U.C. Berkeley).

Oenothera pulcherrima var. *brauntoni* Lév., Monog. Onoth. 265. 1908. Type: Los Angeles, California, *E. Braunton*, June 1, 1902. Isotype (Stanford) examined.

Godetia brevistyla Piper, Proc. Biol. Soc. Wash. 37: 92. 1924. Type: Olympic Mountains, Clallam County, Washington. *Elmer 2567* (U.S. Nat. Herb.).

Distribution (see fig. 13).—BAJA CALIFORNIA. ARIZONA. Gila and Pima counties. CALIFORNIA. Alameda, Amador, Butte, Calaveras, Colusa, Contra Costa, Eldorado, Fresno, Glenn, Humboldt, Kern, Lake, Lassen, Los Angeles, Madera, Marin, Mariposa, Mendocino, Merced, Monterey, Napa, Nevada, Orange, Placer, Plumas, Riverside, Sacramento, San Benito, San Bernardino, San Diego, San Francisco, San Luis Obispo, San Mateo, Santa Barbara, Santa Clara, Santa Cruz, Shasta, Siskiyou, Solano, Sonoma, Stanislaus, Sutter, Tehama, Trinity, Tulare, Tuolumne, Ventura, Yolo, and Yuba counties OREGON. Benton, Clackamas, Columbia, Curry, Douglas, Hood River, Jackson, Josephine, Linn, Marion, Multnomah, Wasco, Washington, and Yamhill counties. WASHINGTON. Clallam, Klickitat, Pierce, Thurston, and Yakima counties. Open sites in grassland, woodland, chaparral, and coastal sage.

Representative specimens.—BAJA CALIFORNIA. 10 miles north of Ensenada, *Canby* in 1925; 11.6 miles north of Sauzal on road to Guadalupe, *Wiggins 10088*. CALIFORNIA. Alameda County: Oakland Hills, *Mason 906*. Amador County: 2.5 miles northeast of Jackson, *Hitchcock 30*. Butte County: Chico, *Bruce 57*. Calaveras County: near Burson, *Stanford 1004*. Contra Costa County: Blackberg Spring, *Bowerman 2122*. Eldorado County: Garden Valley, *Jones* in 1883. Fresno County: Watts Valley side of grade near summit on road to Trimmer, *Wolf 5069* Glenn County: near Bennett Spring on Newville-Covelo Road, *Heller 11540*. Humboldt County: Garberville, *Munz 9886*. Kern County: north grade of Tehachapi Pass, *Munz 11429*. Lake County: near Lakeport, *C. F. Baker 3060*. Los Angeles County: Evey's Canyon, *Hitchcock 53;* Hay Press, Santa Catalina Island, *Fosberg 8155*. Madera County: San Joaquin Range Experiment Station, *Biswell 149*. Marin County: Hills above Fairfax, *Brandegee* in 1905. Mariposa County: 2 miles above Bagby on grade to Bear Valley, *Wolf 4849*, Mendocino County: 15 miles north of Ukiah, *Munz 9867*. Monterey County: Tassajara Hot Springs, *Elmer 3185*. Napa County: Howell Mountain, 10 miles west of St. Helena, *Bacigalupi 1857*. Orange County: one-fourth mile southwest of Muddy Springs near Roundtop Peak, Rancho Santa Ana, *Johnson 4996*. Plumas County: between Taylorville and Crescent Mills, *Heller & Kennedy 8827*. Riverside County: 15 miles south of Hemet, *Munz 10888*. San Bernardino County: Sawpit Canyon, San Bernardino Mountains, *Clokey & Anderson 6769*. San Diego County: San Onofre Canyon, *Hitchcock 550*. San Francisco County: Lake Merced, *Brandegee* in 1907. San Luis Obispo County: Price Canyon, 1 mile south of Edna, *Hitchcock 3*. Santa Barbara County: 10 miles west of Buellton, *Munz 10299*. Santa Clara County: foothills near Stanford University, *C. F. Baker 859*. Santa Clara County: Santa Cruz, *Jones* in 1886. Shasta County: 2 miles west of Fall River Mills, *Hitchcock 6624*. Siskiyou County: Klamath Hills, *Butler 1375*. Solano County: Dutton Canyon, west of Vacaville, *Heller 16494*. Sonoma County: open hills around Knights Valley, *Parks 0606*. Stanislaus County: 8 miles east of Oakdale, *Hoover 2034*. Sutter County: slope of West Butte, Marysville Buttes, *Ferris 6373*. Tehama County: 7 miles south of Corning, *Munz 13205*. Trinity County: Mad River, 5 8 miles above Eureka-Red Bluff Road on road to Ruth, *Wolf 8927* and *8925*. Tulare County: 10 miles east of Exeter on road to Yokohl Valley, *Wolf 4710*. Tuolumne County: near Bear Creek, *Williamson 58*. Ventura County: burn near Kennedy Canyon, *Pollard* in 1946. OREGON. Clackamas County: bluffs on west side of Willamette River above the falls, Oregon City, *Constance & Beetle 2771*. Hood River County: Odell, *Peck 9875*. Jackson County: 7 miles southwest of Prospect, *Hitchcock & Martin 5007*. Josephine County: west fork of Illinois River near Floyd School, *Abrams 8639;* Waldo, *Munz 9894*. Multnomah County: Lower Albina, Portland, *Sheldon 10975*. WASHINGTON. Klickitat County: open forest northwest of Bingen, *Suksdorf 5689;* 5 miles west of Bingen in shale above Columbia River, *Hitchcock 13763*.

Progenies from the following localities have been studied in the experimental garden. CALIFORNIA. Amador County: southern city limit of Amador, *366;* 5.3 miles north of Plymouth, *370*. Butte County: 2.4 miles east of Oroville on Highway 21, *56;* 11 miles northeast of Oroville, *62;* 0 7 mile south of Oregon House P.O. on road to Stanfield Hill, *390;* 4.6 miles north of Bangor, *392;* 6.4 miles southeast of Oroville on road to Bangor, *395;* road to Paradise, 2.5 miles north of Oroville-Chico Road, *396;* 1.3 miles north of Clear Creek School on road to Paradise, *397*. Calaveras County: Highway 120, 0.5 mile west of Copperopolis, *141;* 1 2 miles north of San Antonio Creek Bridge on Highway 19, *359;* 0.2 mile north of North Fork of Calaveras River on Highway 49, *360;* 4.3 miles east of Mokelumne Hill on road to West Point, *363;* 1.7 miles west of Pine Grove School on Sutter Creek Road, *364* Eldorado County: Highway 49, 2.2 miles north of county line, *372;* 1.75 miles south of Eldorado, *374;* 2 miles south of Coloma P.O., *376;* Pilot Hill–Salmon Falls Road, 1 mile south of bridge over South Fork of American River *381*. Fresno County: 3.2 miles north of Academy P.O., *26;* 0.6 mile north of road to O'Neals on road to Wawona, *323;* 2.6 miles north of road to O'Neals on road to Wawona, *326*. Lake County: Highway 20, 1.9 miles east of junction of Highway 53, *64;* Clear Lake Oaks on Highway 20, *66;* Highway 20, 11.9 miles east of junction with Highway 53, *74;* 0.1 mile east of junction of Kelseyville and Lower Lake Roads, *88;* Highway 20, 3 miles east of junction with Highway 29, *90;* Road to Kelseyville, 1 mile west of junction of Highway 53, *100;* 0.2 mile east of junction of Kelseyville -Lower Lake Road, *105;* 2.7 miles north of Lake County line on Highway 29, *107*. Los Angeles County: 0.7 mile north of junction of Sepulveda Boulevard and North Sepulveda Way, *28;* 0.1 mile east of Canoga Ave. on Mulholland Drive, *36;* Decker Road, 0.5 mile north of road to Latigo Canyon, *445*. Madera County: 4.4 miles south of North Fork, *23*. Mariposa County: El Portal, *333;* 0.1 mile south of Mariposa on road to Mormon Bar, *337;* 1.0 mile south of Mariposa on road to Mormon Bar, *338;* Mormon Bar to Highway 140, 5.2 miles south of Wawona Road, *339;* 0.5 mile west of road to Hornitos on Highway 49, *341*. Mendocino County: 6.9 miles east of U S. Highway 101 on Highway 20, *75;* 9 2 miles north of Willets city limit on U.S. Highway 101, *78;* 4.5 miles west of Lake County line on Hopland Road, *79;* Willets, hill opposite Veterans Memorial, *92;* 6.3 miles west of Lake County line on Hopland Road, *106;* Covelo Road east of U.S. Highway 101, *131A;* 4.1 miles south of Lakeport-Hopland Road on U.S. Highway 101, *137*. Merced County: Snelling to Lake Yosemite Road, first intersection beyond Merced River Bridge, *852*. Napa County: 2.7 miles north of Calistoga on Highway 29, *127;* 2 2 miles north of Calistoga on Highway 29, *94*. Orange County: Rancho Santa Ana, *153*. Placer County: 3.1 miles south of North San Juan P.O. on Highway 49, *388*. San Bernardino County: Sand Canyon, *264* and *265*. San Diego County: 2.1 miles east of Cleveland National Forest Boundary on road to Barrett Lake, *279*. San Luis Obispo County: 2.3 miles from U.S Highway 101 on the Santa Margarita to Creston road, *40;* Salinas River Bridge on the Santa Margarita to Creston road, *45;* 0.5 mile west of Eldorado School, *47;* 9.3 miles northwest of Adelaida Cemetery, *53;* summit on road between Atascadero and Morro Beach, *474;* 9.8 miles east of Creston Road on Santa Margarita Pozo Road, *478;* 1.1 miles east of U.S. Highway 101 on Santa Margarita–Pozo Road, *518;* 9.6 miles east of U.S. Highway 101 on Santa Margarita–Pozo Road, *522*. Santa Barbara County: 1.1 miles east of bridge 3 20 on Las Cruces Lompoc Road, *464;* 5 7 miles south of Highway 1 on road to Jalama, *467*. Shasta County: 1.0 miles east of Millville School on Redding to Mt. Lassen Road, *399;* 1.6 miles east of Millville School on Redding to Mt. Lassen Road, *400;* 0.7 mile west of Clear Creek Bridge 6 36 on U.S. Highway 299, *401*. Tuolumne County: 4.9 miles north of Tuolumne County line on Highway 49, *351;* 1.6 miles north of Jacksonville on road to Stent, *353*. Yuba County: Highway 20, 2.8 miles east of junction with Dobbins–Brown Valley Road, *57*. WASHINGTON: Klickitat County: 5.3 miles west of Bingen, *887*.

The normal haploid chromosome number is 26 (Håkansson, 1941*b*). Our counts are based upon examination of microsporocytes of one plant from each of the following populations: *23*, *78*, *279*, *333*, *401*, *474*, and *887*. One plant from population *57* apparently had genomes of 25 rather than 26 chromosomes. Root-tip preparations of the following populations showed approximately 52 chromosomes, but the counts were not certain: *40*, *47*, *75*, *264*, and *396*. Johansen reported a haploid number of

14 for this subspecies (as *G. quadrivulnera*) for material from the Stanford Campus (Johansen, 1927) and Håkansson (1925) reported a haploid number of 21 for *G. lepida*, which is probably referable to this subspecies. Our observations and those of Håkansson (1941*b*) indicate that the earlier counts were undoubtedly in error.

Included within this subspecies are the numerous self-pollinating forms of *C. purpurea*. They may differ conspicuously from population to population with respect to the color of the flowers, pubescence, and habit. But they all have small flowers with petals usually a centimeter or less in length. The stigma is receptive at the time the stamens mature, and the anthers usually adhere to the stigma and deposit their pollen directly upon it. Pollination usually occurs in the unopened bud. Different local races may vary with respect to the degree of self-pollination, however, and no sharp distinction between self-pollinating races and those that are normally outcrossed can be made. For example, in some populations the stamens diverge from the stigma before the pollen is shed, thus offering an opportunity for outcrossing. But the petals of these plants close at night, and in closing they usually bring the anthers into contact with the stigma. Therefore, if outcrossing does not occur during the first day the flower is open, self-pollination usually occurs in the evening. Self-pollination has promoted the formation of a multitude of morphologically distinct local races, some of which may grow together at the same site. We have made no attempt to name them. A formal nomenclature has, however, been applied to many of these variants, but an even greater number have not been named. The characters that have been used to distinguish some of the described variants are at least in part environmentally determined. For example, we have grown progenies from a number of very compact forms of the sort that have been referred to *Godetia purpurea* var. *parviflora* (Hitchcock, 1930), but they did not retain their compact inflorescences under cultivation. At the same time, many differences in habit that would be difficult to detect in most natural populations become evident under uniform garden conditions. Some strains are much branched, others are not; some branch only near the base, others only near the top. Some variable morphological characters apparently have a certain geographical continuity, as is true of some of the color patterns. Other traits such as a congested inflorescence or broad leaves are seemingly sporadic throughout the entire range of the complex.

Relationship.—*Clarkia purpurea* is morphologically similar to the allohexaploid species *C. affinis*, and the two probably have had a tetraploid parent in common (see *C. affinis*). They differ most conspicuously in the slender capsule of the latter as opposed to the stocky capsules of the former. Furthermore, the sepals of *C. affinis* remain united and deflexed to one side at anthesis, whereas those of *C. purpurea* are usually reflexed individually. Hybrids between the two species have a greatly reduced fertility, but progeny can be obtained from backcrossing. Some populations in nature strongly suggest that natural hybridization has occurred. This is especially true of many populations in the vicinity of Mt. Diablo, Contra Costa County, California. Some of these populations may represent stabilized true-breeding strains of hybrid derivation. The type specimen of *Godetia quadrivulnera* var *vacensis* Jeps. may be a hybrid between these two species. *Clarkia purpurea* does not seem to be directly related to the other allohexaploid species, *C. prostrata*. (See *C. prostrata.*)

Clarkia purpurea resembles the tetraploid South American species *C. tenella* both morphologically and in degree of morphological divergence. It seems probable that the tetraploid ancestor or ancestors of *C. purpurea* was very close to *C. tenella* if that species was not actually involved. We have had no opportunity to examine this relationship experimentally. Chittenden (1928) obtained hybrids between garden strains of *C. tenella* and *C. purpurea* (*Godetia lepida*). Unfortunately, the hybrids were not examined cytologically. These hybrids were quite sterile with only about 5 per cent visibly good pollen. He obtained an F_2 of six individuals, however, and progenies of seventeen and fourteen when backcrossed to *C. tenella* and *C. purpurea*, respectively.

The flowers of some forms of *C. purpurea quadrivulnera* are scarcely distinguishable from those of the tetraploid species *C. davyi*, an ecologically specialized coastal species. There is, however, no indication that *C. davyi* has been directly involved in the formation of the hexaploid *C. purpurea*, although *C. davyi* is the only species known in North America which is probably derived from the tetraploid stock ancestral to *C. purpurea*. *Clarkia purpurea* and *C. davyi* probably hybridize today in the vicinity of San Francisco, and a certain amount of genetic amalgamation has apparently occurred although the hybrid is quite sterile. This at least is our interpretation of the populations which we have seen near Lake Merced and those from the same area which have been accumulating in the herbaria over a period of decades. There is no indication that this amalgam is a phenomenon of the last few years.

The diploid species which contributed a genome of 9 to *C. purpurea* may have been one or more of those in Section Godetia. The close morphological resemblance of certain forms of *C. purpurea* to these diploid species may offer a clue as to the species involved or it may merely indicate recent hybridization with *C. purpurea* (see *C. williamsonii*). For example, a collection from Price Canyon, 3 miles south of Edna, San Luis Obispo County, California (*Hitchcock 37*), is apparently *C. purpurea* but strongly suggests *C. speciosa immaculata* which grows in the same area. The interspecific hybrid between these species is nearly sterile in the garden, but a few seeds can be obtained by backcrossing, especially when *C. purpurea* is used. At the same time, we have found variants in a natural population of *C. speciosa immaculata* which also suggest derivatives from a cross involving *C. purpurea*.

SECTION BIORTIS SEC. NOV.

Herbae erectae; caulibus pubescentibus; inflorescentium axe recto; calycis tubo obconico 1.5–4 mm. longo, annulo pilorum ad medium vel infra posito; calycis limbo sub anthesi connato et declinato; petalis obovatis, sine unguiculis; staminibus 8; antheris obtusis; filamentis erectis; ovario gracili, 8-canaliculato.

Erect herbs; stems puberulent; rachis of the inflorescence erect; buds erect; hypanthium obconical, 1.5–4 mm. long, the ring of hairs in the middle or below; sepals remaining united and deflexed to one side at anthesis; petals obovate, the claws inconspicuous or absent; stamens 8, in two similar series; anthers obtuse; filaments erect; immature capsule slender, 8-grooved

Type species.—C. affinis Lewis & Lewis.

Relationship.—The only species in this section is of alloploid origin and combines chromosome complements derived from a tetraploid species in Section Godetia with a genome which has been derived from a diploid species probably in Section Peripetasma.

14. **Clarkia affinis** Lewis & Lewis, Madroño 12: 34. 1953. (Fig. 12, *e, f*.)

Erect, as much as 8 dm. tall, simple or branched above; stems slender, pubescent above with short, upwardly curled hairs, sparsely puberulent or glabrate below; leaves linear to narrowly lanceolate, entire, puberulent, 1.5–7 cm. long, 2–5 mm. broad, sessile or narrowed into petioles as much as 3 mm. long; rachis of the inflorescence erect, buds erect; hypanthium obconical, puberulent with appressed hairs, 1.5–4 mm. long, the ring of hairs at or below the middle; sepals lanceolate, often attenuate at the tip, 5–10 (14) mm. long, 1.5–2 mm. broad, appressed puberulent, usually remaining united and deflexed to one side in anthesis; petals obovate, subentire to erose, 5-15 mm. long, pale pink to lavender pink, sometimes dark reddish-purple, usually lighter near the base, often flecked or penciled with purple; stamens 8, white to yellow, sometimes purple-spotted, usually adhering to the stigma and depositing the cream to whitish pollen upon it as the flower opens; stigma lavender to purple with 4 short lobes; style shorter than the stamens; ovary slender, densely gray puberulent with short, upwardly appressed hairs, 1–2.5 cm. long; immature capsule usually at least 10 times as long as broad; shallowly 8-grooved, sessile or sometimes on a pedicel as much as 4 mm. long, gradually tapering into a slender beak 3–7 mm. long; mature capsule subterete or 4-sided, 1.5–3 cm. long, 1 5–2 mm. broad, straight or slightly curved, opening only after a period of weeks or several months; seeds brown or grayish, scaly, 1–1.5 mm. long, the crest as much as 0.1 mm. long.

Type.—Santa Margarita to Pozo road, 9.8 miles west of the junction with the road to Creston, San Luis Obispo County, California, *Lewis & Epling 181*, May 2, 1947 (U.C.L.A.).

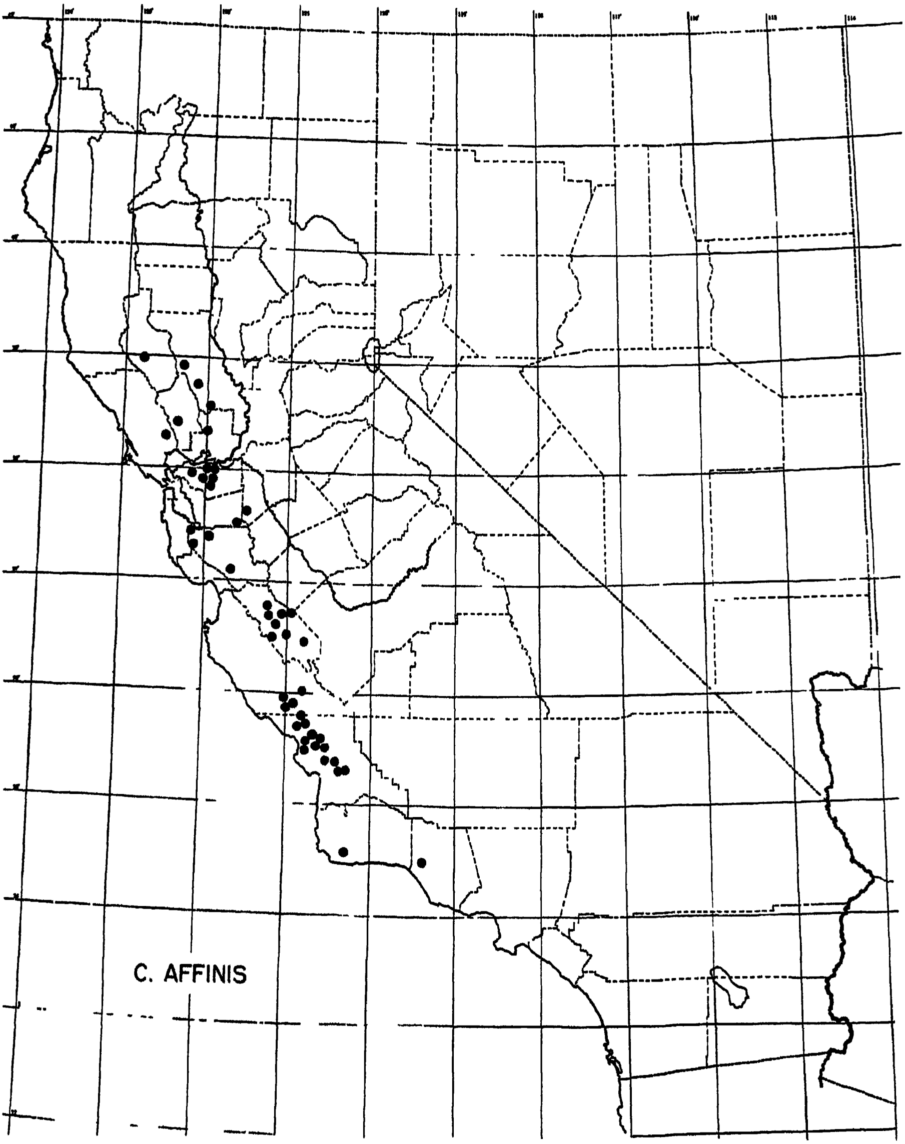
Distribution (see fig. 14).—California. Alameda, Colusa, Contra Costa, Lake, Monterey, Napa, San Benito, San Joaquin, San Luis Obispo, Santa Barbara, Santa Clara, Solano, Sonoma, Ventura, and Yolo counties. Woodland and chaparral of the Coast Ranges.

Representative specimens.—California. Alameda County: Corral Hollow Road, 18 miles west of junction with U S. Highway 50 at Tracy, *Lewis & Epling 198;* lower part of Arroyo Mocho, *Howell 18104*. Contra Costa County: 3.7 miles ENE of Tassajera, *Belshaw 2114;* north side of Mt. Diablo, *Howell 6483*. Monterey County: road to Pleyto, 2 miles south of the Bradley-Jolon Road, *Lewis & Epling 193;* 2.5 miles NNW of Pleyto Well, *Graham 400*. San Benito County: 5 miles from Panoche-Idria Road, near mouth of canyon of Griswold Creek, *Wiggins & Ferris 9368;* 6 miles east of Paicines, *Howell 12969* and *12970*. San Joaquin County: Corral Hollow, *Howell 28309*. San Luis Obispo County: north road to Adelaida, 8.8 miles west of U.S. Highway 101, *Lewis & Epling 189;* roadside 2 miles east of Santa Margarita on Highway 178, *Ferris & Rossbach 9432*. Santa Barbara County: summit of Nojoqui Pass, Santa Ynez Mountains, *Keck & Hiesey 5138*. Santa Clara County: near Cupertino, *Heller 8552;* Uvas-Almaden Road, *Mason 6947*. Solano County: near Vacaville, *Jepson* in 1891. Sonoma County: Hills east of Agua Caliente, *Raven 2781*. Ventura County: Ojai Valley, *Hall 3192*. Yolo County: Banks of Putah Creek, near Winters, *Heller & Brown 5584*.

Progenies from the following localities have been studied in the experimental garden. Contra Costa County: Beck Road to Livermore, 1 mile south of Marsh Creek Road, *172*. Lake County: Highway 20, 1.9 miles east of Highway 53, *63*. Monterey County: Bradley-Jolon Road, 10.7 miles west of U.S. Highway 101, *48*. San Luis Obispo County: 9.3 miles north of Adelaida Cemetery, *52;* Santa Margarita–Pozo Road (type locality), *480;* summit between Atascadero and Morro Bay, *475;* road to Adelaida, 11.2 miles west of U.S. Highway 101, *555*.

The haploid chromosome number is 26, based upon examination of microsporocytes of one or more individuals from each of the following collections: *52*, *475*, and *480*. No meiotic irregularities have been observed.

Clarkia affinis is, on the whole, a relatively homogeneous species except for conspicuous variation in petal color and marking. This variation is evident within individual colonies, as well as between colonies. The petals may be pale pink to a rich purplish-red, and among the individuals with lighter-colored flowers the petals are often flecked with reddish-purple. In certain areas, notably in the vicinity of Mt. Diablo, Contra Costa County, the lighter-colored petals may have a darker lavender or purplish wedge-shaped spot at the apex similar to that frequently found in the closely related species, *C. purpurea*. The sympatric distribution of these two species in this area and the fertility of their hybrids, although low, as indicated under cultivation, suggest that gene exchange may occur between them. Very different color forms of *C. affinis* are frequently found growing together in the same population



CALIFORNIA—NEVADA

Fig. 14. Distribution of *Clarkia affinis*.

with no apparent intermediates, although intermediates can be produced in the garden. The maintenance of these differences within natural populations is undoubtedly due to self-pollination, which is characteristic of this species. As a rule, pollen of a given flower is deposited on its own stigma before or at the time the flower opens. Extensive self-pollination is also indicated by the extreme uniformity of large progenies derived from controlled self-pollinations of individuals with different color patterns. However, outcrossing apparently does occur with a certain, probably low, frequency, as is indicated by occasional heterogeneous populations which suggest recent hybridization of contrasting color forms (e.g., in the vicinity of the Pinnacles National Monument, San Benito County).

Relationship.—*Clarkia affinis* is morphologically similar and closely related to *C. purpurea.* The latter can be distinguished, however, on the basis of its more massive capsules, which when immature are very strongly 8-ribbed and not more than 8 times as long as broad. In contrast, the slender, shallowly grooved immature capsules of *C. affinis* are usually at least 10 times as long as broad and taper upward into a relatively slender beak. These differences are less apparent or obscure in mature capsules and herbarium specimens. The sepals of *C. purpurea*, however, are characteristically reflexed individually or in pairs, whereas those of *C. affinis* normally remain together and are merely deflexed to one side. Furthermore, the former is not known to have flecked petals, which are frequent in the latter. In most respects, the two species overlap morphologically, and natural hybridization apparently does occur.

Hybrids between *C. affinis* and *C. purpurea* can be produced readily, but in all cases they have shown a marked reduction in fertility when selfed, backcrossed, or open-pollinated in the experimental garden. As a rule no viable seeds were produced from controlled self-pollination of the F_1. The largest F_2 progeny to reach maturity consisted of only four individuals. Although self-pollination is the rule in both parents, the mechanism is ineffective in a sterile hybrid. It follows, therefore, that such hybrids when formed in nature will in general be backcrossed. Progenies produced by backcrossing ranged from a few to as many as seventeen individuals. Some of these individuals were quite fertile when self-pollinated, indicating that fertile self-pollinating strains may be produced rather rapidly following this particular interspecific hybridization.

Meiosis has been studied in an F_1 hybrid (*C. purpurea, 53*, Sand Canyon, San Bernardino County × *C. affinis, 52*, 9.3 miles north of Adelaida Cemetery, San Luis Obispo County). The first metaphase could be completely analyzed in three microsporocytes. One of these showed 17 bivalents and 18 univalents, another had 15 bivalents, 2 chains of 3, and 16 univalents; a third cell had 14 bivalents, 1 ring of 4, and 20 univalents. These configurations suggest that *C. purpurea* and *C. affinis* may have a common or very closely related ancestor with 17 chromosomes and that they differ by a genome of 9. On morphological grounds, as well as chromosome number, the species which contributed the genome of 17 common to both *C. affinis* and *C. purpurea* was very similar to *C. tenella*, a South American species, or perhaps to a species with 17 chromosomes from which *C. tenella* and *C. davyi* have both been differentiated. The source of the genome of 9 in *C. affinis* is uncertain, but some inference can be made on morphological grounds. *Clarkia affinis* differs from its 17 chromosome ancestor in several respects. The sepals remain united at anthesis, the petals are flecked, and the capsules are more slender. The species which possess these traits and which might have contributed a genome of 9 are *C. cylindrica, C. deflexa*, and perhaps *C. modesta*, although the latter characteristically has but 8 pairs of chromosomes. Unsuccessful attempts have been made to cross *C. affinis* with the first two species. Pollinations involving *C. modesta* and *C. affinis* have not yet been made.

Clarkia affinis is morphologically very distinct from *C. prostrata,* another allohexaploid species with the same chromosome number. They are probably not directly related. The hybrid between them is highly sterile.

Section Peripetasma sec. nov.

Herbae erectae; caulibus pubescentibus raro subglabris; inflorescentium axe in apice recurvato; calycis tubo obconico, 0.5-5 mm. longo, annulo pilorum ad apicem interdum in medio ornato; calycis limbo sub anthesi connato et declinato; petalis 5–35 mm. longis, oblanceolatis vel obovatis vel flabelliformis interdum bilobis, semper ferme purpureo-punctulatis, unguiculis brevis; staminibus 8, circulis duo dissimilibus; antheris obtusis quam filamenta brevioribus; filamentis gracilibus; ovario 4- vel 8-canaliculato vel 8-costato.

Erect herbs; stems puberulent, at least above, with short, upwardly curled hairs, rarely glabrate; rachis of the inflorescence recurved in bud, the buds pendulous; hypanthium obconical, 0.5–5 mm. long, the ring of hairs at the middle or more frequently at or near the apex; sepals remaining united and deflexed to one side at anthesis; petals 5–35 mm. long, oblanceolate to obovate or fan-shaped, sometimes bilobed, usually flecked with reddish purple, the claw short or obscure; stamens 8, in two series, the inner usually with cream-colored pollen, the outer with blue pollen; anthers obtuse, shorter than the filaments; filaments slender; immature capsule 4- or 8-grooved or 8-ribbed.

Type species.—*C. bottae* (Spach) Lewis and Lewis.

Section Peripetasma is comprised of three morphologically well-defined diploid subsections and a derived alloploid subsection. The diploid subsections are (1) Peripetasma, including *C. bottae* and *C. cylindrica;* (2) Lautiflorae, including *C. biloba, C. lingulata, C. dudleyana,* and *C. modesta;* (3) Micranthae, comprised of *C. epilobioides.* The tetraploid Subsection Prognatae includes only *C. similis,* which combines genomes derived from subsections Lautiflorae and Micranthae. Subsections Peripetasma and Lautiflorae consist of primarily outcrossed species which usually have relatively large and conspicuously colored flowers; Subsection Micranthae consists of a small white-flowered, self-pollinating species. Subsection Peripetasma has flower color patterns that are conspicuously divided into two or three zones of color. The flower color of species in Subsection Lautiflorae is more or less uniform except for flecking or streaking. Subsection Peripetasma is further distinguished from Lautiflorae by terete or grooved immature capsules as opposed to the deeply and conspicuously 8-ribbed immature capsules characteristic of the latter.

Relationship.—Section Peripetasma is similar in many respects to Section Primigenia and has probably been derived from it. Many of the morphological traits which characterize the former are found among the species of the latter. For example, the sepals remain united and deflexed to one side at anthesis in both sections; the reflexed stem tips characteristic of Peripetasma are also found in Subsection Flexicaules of Primigenia. The conformation of the petals is similar in both groups, except perhaps for the petals of *C. biloba, C. lingulata,* and *C. modesta* in Peripetasma. But individuals with bilobed or emarginate petals similar to those of *C. biloba* occur sporadically in Primigenia, whereas the petals of the other two species are merely more narrow than are usually found in Section Primigenia. The most conspicuous morphological difference between these sections is found in the stamens. The filaments are relatively slender in proportion to the anthers in Peripetasma, and the anthers are obtuse. The outer series of stamens is widely divergent and in the same plane as the petals when the flower opens. These stamens usually have larger anthers than the inner series, and the pollen of the outer anthers is characteristically blue, whereas that of the inner is usually cream-colored. The inner stamens remain more or less erect at anthesis; the outer series become erect as the pollen is shed. Exception must be made, however, for the small-flowered, self-pollinating species in which the stamens are not divergent and the pollen is often the same color in both series. The stamens of Primigenia, on the other hand, are disposed in two similar series. The filaments are relatively stout and erect, although the outer are somewhat longer than the inner. The anthers are mucronate or acute, and the pollen is uniform, usually cream to bright orange-yellow in color. The two sections also differ in other characters. For example, most species of Peripetasma have a prominent purplish-red flecking on the petals which is not found in Primigenia. To one familiar with the species of both sections, particularly when grown under uniform cultural conditions, the two sections differ by a summation of rather subtle traits, which are difficult to describe, such as texture and orientation of leaves and general habit of the plants. Nevertheless, these differences are such as to indicate that the morphological and genetic hiatus between the two sections is far greater than that existing between the species within either section. Furthermore, the species of Primigenia have a basic chromosome number of 7, whereas species of Peripetasma have a basic number of 8 or 9.

Section Peripetasma is related to Section Phaeostoma through alloploidy (see Section Connubium). Section Peripetasma may also be related to Section Phaeostoma by way of *C. deflexa* (Section Fibula). This species has flowers very similar

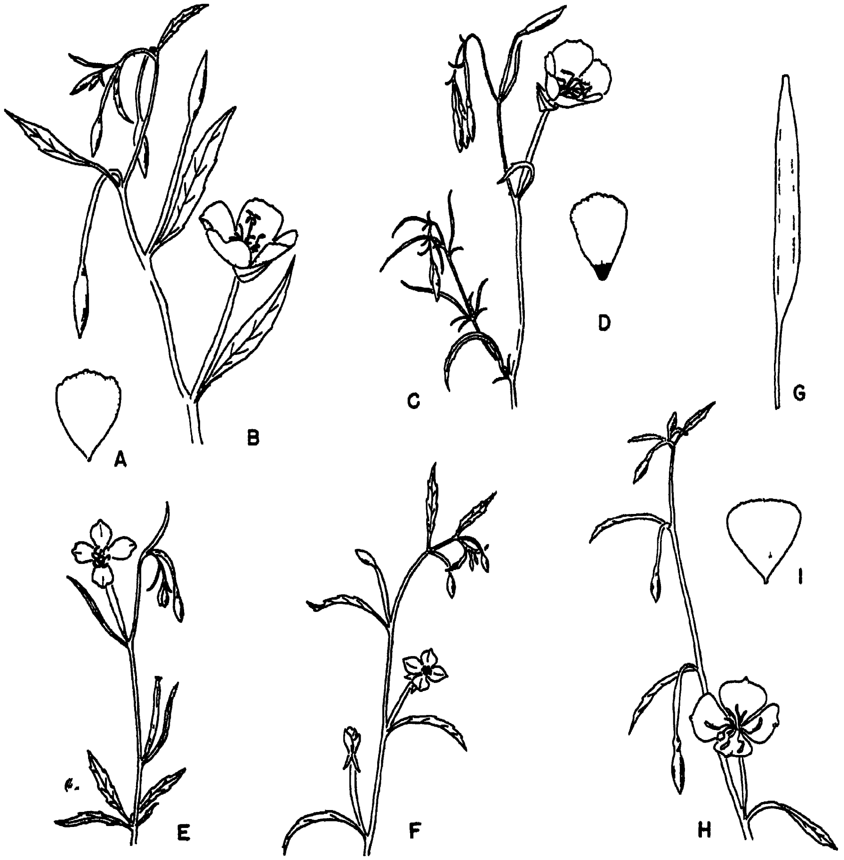


Fig. 15. *a*, *Clarkia bottae*, petal × ½; *b*, inflorescence × ½; *c*, *C. cylindrica*, inflorescence × ½; *d*, petal × ½; *e*, *C. similis*, inflorescence × ½; *f*, *C. epilobioides*, inflorescence × ½; *g*, *C. deflexa*, capsule × 1; *h*, inflorescence × ½; *i*, petal × ½.

in conformation and markings to those found in several species of Peripetasma, but the close similarity stops at this point. In other respects, *C. deflexa* is very similar to species in Section Phacostoma and may represent a hybrid derivative between the two sections (see Section Fibula).

Section Peripetasma is probably also related to Section Godetia through alloploidy (see Section Biortis).

SUBSECTION PERIPETASMA

Flowers protandrous; petals 10–35 mm. long, usually more than 15 mm. long, differentiated into two or three zones of color; mature stigma held above the stamens; immature capsule usually 4-grooved.

15. **Clarkia bottae** (Spach) Lewis and Lewis, Madroño 12: 33. 1953.
(Fig. 15, *a*, *b*.)

Erect, as much as 5 dm. tall; stems simple or more frequently branched, puberulent above with short, upwardly curled hairs, sparsely puberulent or glabrate below; leaf blades narrowly lanceolate to lanceolate, denticulate to subentire, 2–5 cm. long, 3–6 mm. broad, sparsely puberulent to glabrate, narrowed into petioles as much as 7 mm. long; rachis of the inflorescence recurved in bud, becoming erect as the flowers open; hypanthium 1.5–3 mm. long, not colored within, the ring of hairs at the upper margin; sepals lanceolate, 15–20 mm. long, 2.5–3.5 mm. broad, remaining united and deflexed to one side at anthesis; petals fan-shaped, entire to erose, 1–3 cm. long, scarcely clawed, pinkish-lavender above, white below, rarely flecked with reddish-purple, the base the same color as the upper part of the petals, or somewhat darker; stamens 8; anthers lavender, often blotched with red, the outer series characteristically with blue pollen, the inner with cream pollen; filaments white; stigma white, conspicuously 4-lobed; style exceeding the stamens at maturity; ovary puberulent, 15–25 mm. long, sessile or on a pedicel as much as 20 mm. long; immature capsule subterete, shallowly and inconspicuously 4-grooved, scarcely if at all beaked; mature capsule nearly straight, quadrangular to subterete, 2–4 cm. long, 2–2.5 mm. broad; seeds brown, about 1 mm. long, scaly, the crest inconspicuous or none.

Type. Based on the type of *Godetia bottae* Spach. Monterey, California, *Botta* in 1829 (Paris).

Godetia bottae Spach, Nouv. Ann. Mus. Par. III 4: 393. 1835. *Oenothera bottae* Torr. & Gray, Fl. N. Am. 1: 505. 1840. *Oenothera godetia* Steud., Nom. ed. II 2: 206. 1841.

Distribution (see fig. 16). CALIFORNIA. Monterey County. Usually associated with coastal sage or woodland communities; mostly near the coast.

Representative specimens. CALIFORNIA. Monterey County: near Monterey, *Brandegee* in 1908; Monterey, *Guirado 701;* between Monterey and Watsonville, *Hitchcock 11;* between Spreckels and Monterey, *Hitchcock 10;* Point Pinos near Pacific Grove, *Heller 6757;* Carmel Bay, *Elmer 4782;* Bardino, *Elmer 4645.*

Progenies from the following localities have been studied in the experimental garden. Monterey County: Point Lobos, *498;* Highway 1, 2.1 miles south of Malpasso Creek, *719;* Malpasso Creek, 8 miles south of Carmel, *890;* the King City to Jolon road, just south of summit, *494.*

The haploid chromosome number of *C. bottae* is 9. We have examined root tips from two populations, *498* and *494*. The chromosomes are relatively small, as reported by Håkansson (1941*b*) from meiotic studies. His material included a translocation heterozygote, which formed a ring of 4. The material studied by Chittenden (1928) under the name of *Godetia bottae* is certainly *C. deflexa*, on the basis of his description and illustration; *Godetia bottae* of Håkansson (1925) is also probably *C. deflexa* (see Appendix II).

Clarkia bottae is notably variable with respect to habit and to some extent in flower color pattern. Most of the populations have come from near the coast, where they show certain characteristics associated with coastal plants. These coastal plants are short, compact, rather thick-stemmed, with relatively large leaves. Each branch

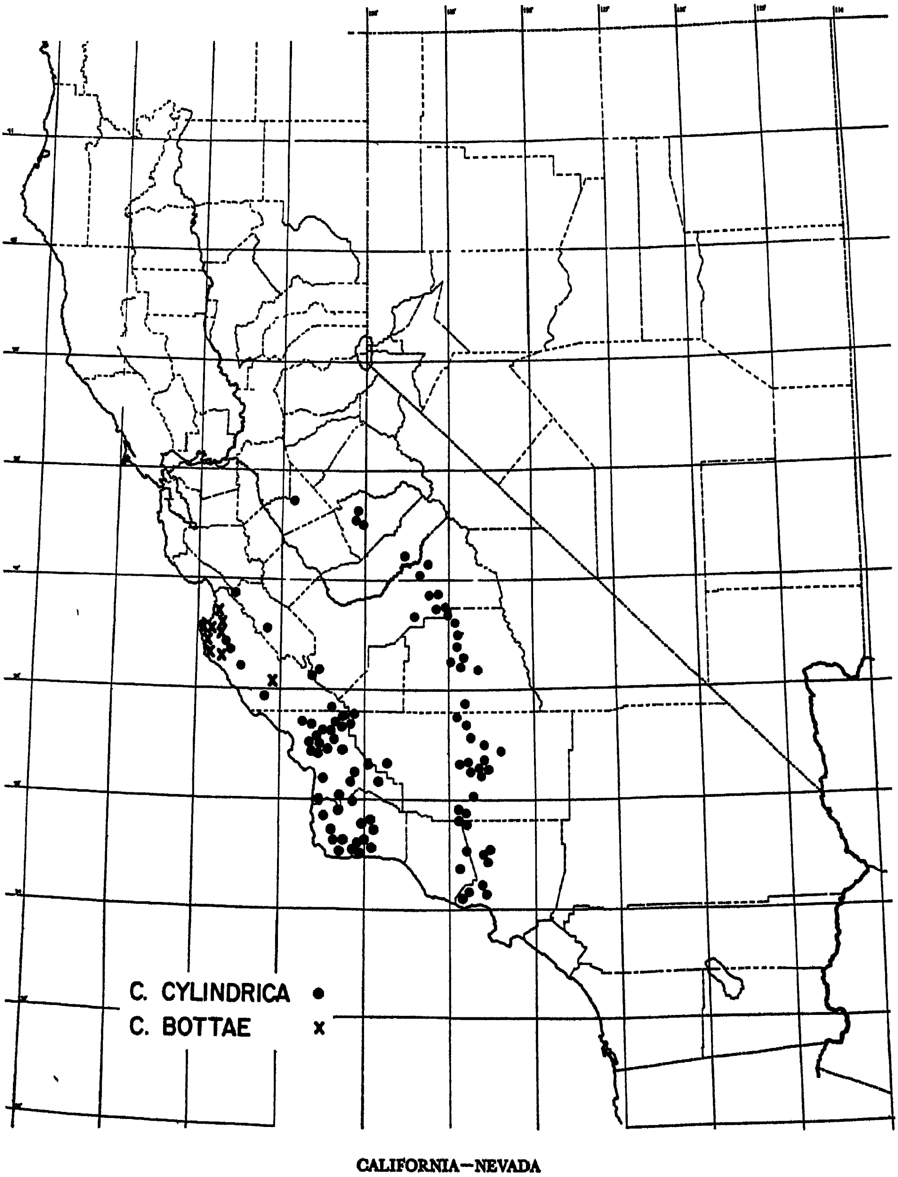


Fig. 16. Distribution of *Clarkia bottae* and *C. cylindrica.*

will bear only one or perhaps as many as four or six relatively large flowers. The more interior populations (e.g., *494*) are slender plants with a habit scarcely to be distinguished from *C. cylindrica*. The leaves are thinner and narrower than the coastal form. The branches have more but smaller flowers. These differences are maintained under uniform cultural conditions in the garden. The flower color pattern often is variable within a population. Individuals may differ in the amount of white on the petal and particularly in the intensity and extent of the color at the base of the petal. The base of the petal is the same color as the uppermost part but is usually a shade or two darker, and sometimes it is conspicuously darker. Flowers with the darker base are scarcely, if at all, distinguishable from those of some *C. cylindrica* individuals. However, the latter are usually, but not always, conspicuously flecked with purple. The capsules of *C. bottae* are relatively uniform, terete, or obscurely grooved.

Relationship.—*Clarkia bottae* is very closely related to *C. cylindrica* and a sharp line of distinction cannot be drawn between them, particularly in the interior of Monterey County. On the basis of morphological intermediates, the two taxa might be considered subspecies. In their typical expressions, however, they are morphologically very distinct and can be readily distinguished by the larger hypanthium of *C. cylindrica*, which is colored a deep reddish-purple within and has a ring of hairs near the middle. *Clarkia bottae*, on the other hand, has a very short hypanthium, which is closed at the top by the ring of hairs and is not colored within. Furthermore, the former characteristically has a dark purplish-red zone at the base of the petal which is absent in *C. bottae*. The capsules of *C. cylindrica* are slender or enlarged above and have a prominent beak, whereas those of *C. bottae* are relatively heavy and beakless. Before the capsules dry, those of *C. bottae* are but faintly and shallowly grooved, whereas at the same stage of development those of *C. cylindrica* are conspicuously grooved. The seeds of *C. bottae* are not as a rule crested, whereas those of *C. cylindrica* have a short but obvious crest. In addition to the conspicuous morphological differences, the two taxa are intersterile, so far as we have been able to determine. Consequently, it seems best, for the present, to recognize them as two species. They may, however, be hybridizing in the area of overlapping distribution.

Clarkia bottae has been confused with *C. deflexa* (Hitchcock, 1930). Flowers of the two species are similar in shape, and they have similar capsules and stamens. The morphological differences, however, are numerous. The former has drooping leaders with pendulous buds, the latter has erect leaders with deflexed buds, and the buds differ conspicuously in conformation. The buds of *C. bottae* are conical; those of *C. deflexa* are pyramidal. The stems of the former are puberulent, whereas those of the latter are glabrous, or nearly so, and glaucous. The leaves are very different in size and texture and the petals of *C. deflexa* do not have the broad zone of white which characterizes *C. bottae*. The morphological differences are such as to warrant not only specific but sectional recognition. Furthermore, the chromosomes of *C. deflexa* are much larger than those of *C. bottae* (Håkansson, 1941*b*), and this difference in size is maintained in the hybrid (Håkansson, 1943*b*). These hybrids are very sterile and show very poor meiotic pairing with over 50 per cent of the microsporocytes showing only univalents. In the remaining cells, one or a few bivalents are found.

16. **Clarkia cylindrica** (Jepson) Lewis & Lewis, Madroño 12: 33. 1953.
(Fig. 15, *c*, *d*.)

Erect, as much as 6 dm. tall; stems simple or branched, puberulent above with short, upwardly curled hairs, sometimes sparsely so, sparsely puberulent to glabrate below; leaf blades linear to narrowly lanceolate, entire to denticulate, 1–5 cm. long, 1–5 mm. broad, sparsely puberulent to glabrate, sessile or narrowed to petioles as much as 5 mm. long; rachis of the inflorescence recurved in bud, becoming erect as the flowers open; buds pendulous; hypanthium 3–5 mm. long, colored within, at least above the ring of hairs, the ring of hairs near the middle; sepals reddish-purple, narrowly lanceolate, 1–2.5 cm. long, 1.5–3 mm. broad, remaining united and deflexed to one side at anthesis; petals fan-shaped, entire to erose, 1–3.5 cm. long, purple to pinkish-lavender shading to white in the middle, usually flecked with reddish-purple, usually with a bright purplish-red base, scarcely clawed or the claw not more than 2 mm. long; stamens 8, the outer characteristically with bluish pollen, the inner, shorter, with yellowish or bluish-gray pollen; stigma white to yellowish, conspicuously 4-lobed; style exceeding the stamens at maturity; ovary puberulent, 1.5–3.5 cm. long, sessile or on pedicels as much as 1 cm. long; immature capsule cylindrical or somewhat enlarged above, frequently club-shaped, 4-grooved, often with 4 secondary grooves; mature capsule 4-sided or subterete, often enlarged above, 2–5 cm. long, 1–2 mm. broad, usually attenuated into a beak as much as 1 cm long; seeds brown, 1-1.5 mm. long, scaly, the crest as much as 0.1 mm. long.

Type.—Based on the type of *Godetia bottae* var. *cylindrica* Jepson. Waltham Creek, near Alcalde, Fresno County, California, *Jepson 2656A* (Jepson Herbarium).

Godetia bottae var. *cylindrica* Jeps , U.C. Publ. Bot. 2: 332. 1907. *Godetia cylindrica* Hitch., Bot. Gaz. 89: 352. 1930.

Distribution (see fig. 16).—CALIFORNIA. Fresno, Kern, Los Angeles, Madera, Mariposa, Monterey, San Benito, San Luis Obispo, Santa Barbara, Stanislaus, Tulare, and Ventura counties. Frequent in grassland and adjacent oak-digger pine woodland or chaparral, particularly on the margins of the San Joaquin Valley, where it may form carpets of color visible for miles.

Representative specimens.—CALIFORNIA. Fresno County: 12 miles east of Centerville on the grade to Squaw Valley, *Wolf 4758;* foothills, *Hall and Chandler 10.* Kern County: Kern River Canyon, 4 miles from its mouth, *Abrams 11989;* vicinity of Fort Tejon, *Abrams & Macgregor 274.* Los Angeles County: ⅛ mile north of Newhall Tunnel, *Hitchcock 1;* 8 miles west of Elizabeth Lake, *Hitchcock 55.* Mariposa County: Hell Hollow near Bagby, Merced River Canyon, *Branson* in 1929. Merced County: 5 miles north of Snelling, *Hoover 2058.* Monterey County: Tassajara, *Elmer 3195.* San Benito County: end of road to Hanlon Peak, along Harlan Creek, *Ferris & Wiggins 9804.* San Luis Obispo County: 6 miles east of Huerhuero Creek on Creston to Shandon road, *Ferris 9752;* Santa Barbara County: Gaviota Pass, 2 miles from southern entrance, *Hitchcock 3;* Harris Grade, La Purissima Ridge, *Mason 391.* Stanislaus County: 4 miles south of Oakdale, *Hoover 1019.* Tulare County: Ash Creek Station, *Van Dyke* in 1931. Ventura County: Hopper Creek Canyon near Piru, *Hitchcock 43.*

Progenies from the following localities have been studied in the experimental garden. Fresno County: Dunlap, *164;* Yokohl Valley, *165;* 2 miles west of junction of Dunlap and Reedley roads, *317.* Los Angeles County: 0.4 mile north of Latigo Canyon Road, on the Decker Road, *444.* Madera County: 4.4 miles south of North Fork, *24* San Luis Obispo County: 3.5 miles east of Santa Margarita on road to Creston, *42.* Santa Barbara County: 1 mile north of summit of San Marcos Pass, *448.* Tulare County: 0.7 mile east of Tulare County Fire Station on the Exeter to Springville road, *299;* 1.5 miles west of Tulare County Fire Station on the Exeter to Springville road, *295;* 2.1 miles north of Homer Ranch on the Kaweah River to Badger road, *303.*

The haploid number of chromosomes is 9 (Håkansson, 1913*b*). Our counts are based on root tips from one or more individuals from each of the following populations: Fresno County, *164*, *165;* Tulare County, *299.* The somatic chromosomes are comparable in size to those of *C. bottae.*

Clarkia cylindrica shows considerable morphological variation within colonies, between colonies, and regionally. Perhaps the most conspicuous differences are in the color and color pattern of the petals. The petals are usually lavender above, shading rather abruptly into white in the middle, and the basal 2–5 mm. is a bright reddish-purple. In addition, the petals are usually flecked with dark reddish-purple, especially near the center. The intensity and shade of color and the amount of white may vary appreciably. Furthermore, the base of the petal may be pale, and essentially the color of the upper part. On the whole, the flowers in the Coast Ranges tend to be lighter, with a larger proportion of white, and frequently lack the characteristic basal spot. However, the population with the palest flowers we have observed, aside from sporadic white-flowered individuals, was in the Kern River Canyon near Hobo (Miracle) Hot Springs. The amount of flecking on the petals is extremely variable.

For example, out of a progeny of fifteen from Tulare County (*295*), two had no flecks, one had a very few flecks, ten were about normal, and two were so heavily flecked as to form an almost solid spot of color in the center of the petal. The petals may, in extreme examples, become uniformly the color of the flecks (e.g., South Fork of the Kaweah River, *Lewis & Thompson 955*), as in *C. dudleyana*. In general, the populations from the Coast Ranges tend to have the fewest flecks, and in many instances entire populations will consist of individuals with very few flecks or none at all.

The shape of the capsule also varies. The capsule may be cylindrical or conspicuously club-shaped. All of the material from the Sierra Nevada foothills that we have grown has had capsules that were appreciably swollen above the middle. On the other hand, the populations of the Coast Ranges have cylindrical capsules, for the most part, although the capsules of many individuals may show some enlargement above the middle. The differences are most conspicuous before the capsules become dry.

Three collections from Stanislaus County (4 miles south of Oakdale, *Hoover 1019*, *2022*, and Knights Ferry, *Hoover 3378*) deserve special mention. These are beyond the usual range of distribution of the species in that they are farther north and much farther away from the foothills. On the whole, they have smaller flowers (petals 10–18 mm. long) and slender, long-beaked capsules.

Relationship.—*Clarkia cylindrica* is very closely related to *C. bottae*. The two species replace each other geographically, and in Monterey County, where the two distributions are confluent, one cannot always differentiate between them. Furthermore, those populations of *C. cylindrica* that are geographically closest to *C. bottae* are much more like that species than are populations of *C. cylindrica* from the Sierra Nevada. Morphologically and geographically, the two taxa suggest subspecies. However, as indicated above (see *C. bottae*), they are on the whole morphologically distinct, all of the hybrids between them have been sterile, and meiosis in these hybrids was highly irregular. It seems best, therefore, to recognize them as species.

We have been unable to obtain hybrids between *C. cylindrica* and *C. dudleyana*, and the hybrid with *C. biloba* was sterile. Meiosis in this hybrid (*C. cylindrica*, *24*, × *C. biloba brandegeae*, *158*) was highly irregular. Many microsporocytes showed 17 unpaired chromosomes, whereas the maximum association was 2 pairs, 1 chain of 3, and 10 unpaired chromosomes.

Clarkia cylindrica resembles *C. arcuata*, *C. lassenensis*, and *C. gracilis albicaulis* in petal color pattern and has sometimes been confused with them. *Clarkia cylindrica*, however, can readily be distinguished from them in a number of ways including the conformation of the capsules, stamens, and pollen color.

SUBSECTION LAUTIFLORAE SUBSEC. NOV.

Petalis 10–30 mm. longis, concoloribus; staminibus plerumque quam stylus brevioribus; ovario 8-costato.

Petals 10–30 mm. long, lavender to pink, not differentiated into bands or zones of different color; mature stigma usually held above the stamens, the stamens maturing first; immature capsule conspicuously 8-ribbed or grooved.

Type species. *C. biloba* (Dur.) Nels. & Macbr.

17. **Clarkia biloba** (Durand) Nelson & Macbride, Bot. Gaz. 65: 60. 1918 *in adnot.* (Fig. 17, *b, c, d.*)

Erect, as much as 1 m. tall; stems simple or branched above, puberulent above with short, upwardly curled hairs, sometimes sparsely so, sparsely puberulent below; leaf blades linear to lanceolate, denticulate to entire, 2–6 cm. long, 2–8 mm. broad, glabrate to sparsely puberulent, narrowed into petioles as much as 1.5 cm. long; the rachis of the inflorescence recurved in bud, becoming erect as the flowers open, the buds pendulous; hypanthium 1–4 mm. long, not colored within, the ring of hairs near the upper margin; sepals lanceolate, 6–17 mm. long, 1.5–3.0 mm. broad, bright pink to purplish or greenish, remaining united and deflexed to one side at anthesis; petals narrowly or broadly wedge-shaped, 10–25 mm. long, 3–20 mm. broad, emarginate to conspicuously and deeply bilobed, the lobes as much as one-half the length of the petal, lavender to bright pink or magenta, often flecked with red; stamens 8; anthers of the outer series lavender with blue pollen, the inner shorter, white or lavender with white or blue pollen; stigma 4-lobed, the lobes short, white to magenta; style pale pink, exceeding the stamens at maturity; ovary puberulent, conspicuously 8-ribbed, 5–15 mm. long, sessile or on a pedicel as much as 5 mm. long, becoming bright green and shining; mature capsule straight, 4-sided, the corners rounded, 1–2.5 cm. long, 1.5–2 mm. broad; seeds brown, 1 mm. long, minutely scaly-puberulent, the crest inconspicuous.

Type.—Based on the type of *Oenothera biloba* Durand. Nevada, California, *Pratten.*

The type specimen is uncertain. However, the three sheets in the Durand Herbarium (Paris) have been examined, and one of the sheets of Dr. C. W. Short dated 1855 has been designated as a lectotype. These plants were grown at Louisville, Kentucky, from seeds which may well have been collected by Pratten. Nevada (Nevada City), California is probably not the exact type locality. *Clarkia biloba* subsp. *brandegeae* grows near Nevada City, but it does not match any of the sheets in the Durand Herbarium. It seems certain that the Pratten material came from somewhat farther south.

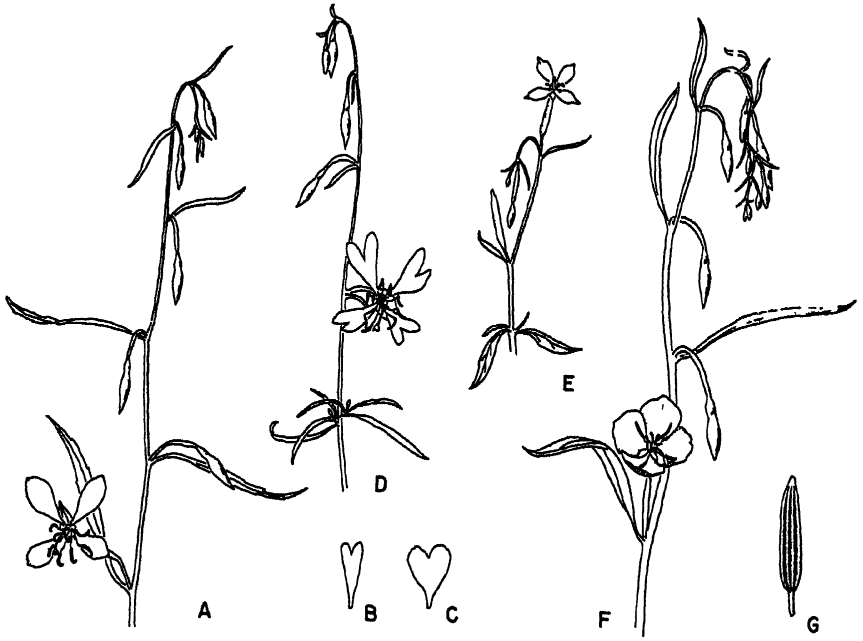


Fig. 17. *a, Clarkia lingulata,* inflorescence × ½; *b, C. biloba* subsp. *australis,* petal × ½; *c, C. biloba* subsp. *brandegeae,* petal × ½; *d, C. biloba* subsp. *biloba,* inflorescence × ½; *e, C. modesta,* inflorescence × ½; *f, C. dudleyana,* inflorescence × ½; *g,* capsule × 1.

Clarkia biloba is a variable species that can be conveniently divided into three geographical races or subspecies. The variation within these subspecies and their relationship to one another has been described in detail by Roberts (1952).

KEY TO THE SUBSPECIES

A. Petals bright pink to magenta, narrowly wedge-shaped; local in the Merced River drainage 17*b*. subsp. *australis*

AA. Petals lavender to pale pink, broadly wedged-shaped.
  B Petals deeply bilobed, the lobes 1/5 to 1/2 the petal length.... .. .. .. .17*a*. subsp. *biloba*
  BB Petals shallowly notched, the lobes less than 1/5 the petal length....17*c*. subsp. *brandegeae*

17*a*. Clarkia biloba subsp. biloba. (Fig. 17, *d*.)

Leaf blades narrowly lanceolate, denticulate to entire, 5–8 mm. broad; rachis of the inflorescence recurved, becoming erect as the flowers open; sepals 6–17 mm. long, reddish or greenish; petals purplish-pink to pale pink, broadly wedge-shaped, 1–2 cm. long, 6–18 mm. broad, deeply bilobed, the lobes as much as one-half the length.

Oenothera biloba Dur., Jour. Acad. Nat. Sc. Phil. Ser. II 3: 87. 1855. *Godetia biloba* Wats., Bot. Calif. 1: 231. 1876. *Oenothera prismatica* var. *biloba* Lév., Monog. Onoth. 264. 1908.

Distribution (see fig. 18).—CALIFORNIA. Amador, Calaveras, Contra Costa, Eldorado, Mariposa, and Tuolumne counties. Usually in oak-digger pine woodland.

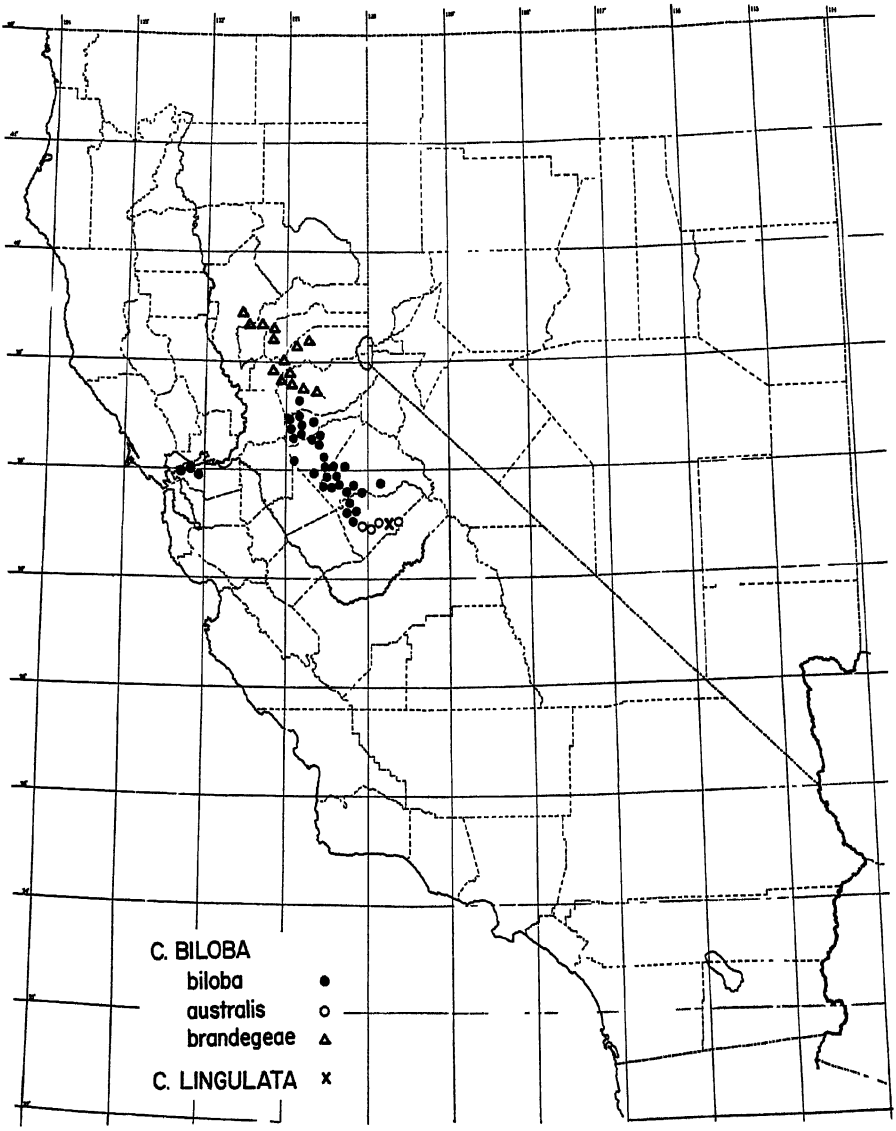
Representative specimens.--CALIFORNIA. Amador County: Caminetti Ranch near Jackson, *Mulliken 108*. Calaveras County: Wallace, *McMurphy* in 1914. Contra Costa County: between Port Costa and Martinez, 1.5 miles from Port Costa, *Hitchcock 13*. Eldorado County: U.S. Highway 50, 3 miles east of Placerville, *Robbins 1069*. Mariposa County: Greeley Hill, near Coulterville, *Evans* in 1901. Tuolumne County: canyon of Spring Gulch, Rawhide, *Williamson 68*.

Progenies from thirteen localities distributed throughout the range of the subspecies have been studied in the experimental garden. Calaveras County: Highway 49, 0.2 mile south of road to Mark Twain Cabin, *810;* Highway 49, 0 5 mile north of Carson Hill Monument, *811;* Contra Costa County: 2.7 miles north of Martinez on road to Port Costa, *442;* Mariposa County: Highway 49, 1.3 miles north of Bagby, *347;* about 10 miles west of Coulterville on road to La Grange, *686*. Tuolumne County: Highway 120 at Cliff House, *123* and *124;* Highway 120, 4.8 miles east of junction with Highway 49 at Moccasin Creek, *140;* Highway 120, 2.5 miles east of junction with Highway 49 at Moccasin Creek, *142;* Highway 120, 0.4 mile west of road to Copperopolis, *143;* Highway 49, 2.6 miles north of Moccasin Creek Powerhouse, *352;* Highway 49, 3.6 miles north of junction with road to Columbia, *356;* Highway 49, 8.9 miles south of Tuolumne River, *807;* Highway 49, 0.5 mile south of Tuolumne River, *808*.

The line of demarcation between *C. biloba biloba* and *C. biloba australis* is sharp with respect to flower color at the Merced River, Mariposa County. The populations on the north side of the river at Bagby have the characteristic lavender or pale-pink petals of *C. biloba biloba*, whereas directly across the river on the south side the petal color is the bright pink to magenta of *C. biloba australis*. The change in petal proportion and leaf shape is not so abrupt. These two subspecies are completely interfertile (Roberts, 1952).

In southern Eldorado County, *C. biloba biloba* and *C. biloba brandegeae* occur intermixed, together with intermediates (e.g., Highway 49, 1.7 miles south of Coloma P.O., *377*). These two subspecies are only partly interfertile. Hybrids produced in the garden were found by Roberts (1952) to be only about 50 per cent fertile. Roberts also found that a progeny grown from a single capsule from population *377* was extremely variable both in morphology and fertility.

The haploid chromosome number of *C. biloba biloba* is 8 (Håkansson, 1941*b;* Lewis, 1949). Microsporocytes of numerous individuals from several populations have been examined.



CALIFORNIA–NEVADA

Fig. 18. Distribution of *Clarkia biloba* and *C. lingulata.*

17*b*. **Clarkia biloba** subsp. **australis** Lewis & Lewis subsp. nov.

(Fig. 17, *b*.)

Foliis linearo-lanceolatis, 2–6 mm. latis, 2–6 cm. longis, integris vel denticulatis; inflorescentium axe in apice recurvato; calycis limbo 7–11 mm. longo, rufulo; petalis pallido-rubris, angusto-cuneatis, 1–2 cm. longis, 3–12 mm. latis, lobis brevibus, 2–6 mm. longis.

Leaf blades linear to narrowly lanceolate, 2–6 mm. broad, entire or nearly so; rachis of the inflorescence recurved, becoming erect as the flowers open; sepals 7–11 mm. long, reddish; petals bright pink to magenta, narrowly wedge-shaped, 1–2 cm. long, 3–12 mm. broad, shallowly lobed, the lobes about ¼ the length.

Type.—Highway 140, Merced River, 1 mile west of junction with the South Fork of the Merced River, Mariposa County, California, *Lewis & Lewis 628*, June 18, 1949 (U.C.L.A.).

Distribution (see fig. 18).—CALIFORNIA. Mariposa County. Near Mariposa and along the south side of the Merced River and adjoining tributaries from Bagby to the South Fork. On steep, dry slopes, at the margin of chaparral and woodland.

Representative specimens.—CALIFORNIA. Mariposa County: 0.9 mile south of the Merced River Bridge at Bagby, *Lewis & Lewis 346;* 0.7 mile west of the South Fork of the Merced River on Highway 140, *Lewis & Lewis 626;* 20 miles north of Mariposa, *Benson 3620;* Hell Hollow, 0.8 mile south of Bagby on the road to Bear Valley, *Wolf 4854.*

Progenies from the following localities have been studied in the experimental garden. Mariposa County: Highway 140, 0.8 and 2.2 miles west of bridge over the South Fork of the Merced River, *336* and *630;* Hell Hollow, *157;* Highway 49, 0.4, 0.9, and 2.1 miles south of Bagby, *804, 803,* and *346,* respectively. In addition, Roberts (1952) has grown and carefully studied ten populations from the Merced River Canyon between the South Fork of the Merced River and Bear Creek.

The haploid chromosome number is 8, based on examination of representatives of all of the populations grown in the experimental garden as well as several bud samples collected from natural populations between the South Fork of the Merced River and Bear Creek, Mariposa County.

Subspecies *australis* occupies an area adjacent to subspecies *biloba,* and the two subspecies form fertile hybrids in the garden. They are readily distinguished by narrower and brighter pink or magenta petals of subspecies *australis.* In both of these respects subspecies *australis* resembles *C. lingulata,* which grows in the same area. The latter may have been derived from subsp. *australis.* No hybrids between these species have been found in nature, and those produced in the garden are nearly sterile.

17*c*. **Clarkia biloba** subsp. **brandegeae** (Jepson) Lewis & Lewis comb. nov. (Fig. 17, *c*.)

Leaves lanceolate, 5-8 mm. broad with a mean near 7 mm., denticulate; the rachis of the inflorescence abruptly recurved, appearing wilted, becoming erect as the flowers open; sepals 9–15 mm. long, pale green; petals lavender to orchid, broad, shallowly bilobed, the lobes not exceeding ⅕ the length.

Type.--Based on the type of *Godetia dudleyana* f. *brandegeae* Jepson. Simpson Ranch, Sweetwater Creek, Eldorado County, California, *Brandegee*, May 29, 1907 (U.C. Berkeley).

Godetia dudleyana f. *brandegeae* Jeps., U.C. Publ. Bot. 2: 334. 1907. *Godetia dudleyana* var. *brandegeae* Jeps., Man. Fl. Pl. Calif. 675. 1925.

Distribution (see fig. 18). -CALIFORNIA. Butte, Eldorado, Nevada, Placer, and Yuba counties. Oak-digger pine woodland of the Sierra Nevada foothills.

Representative specimens. -CALIFORNIA. Butte County: 6.4 miles southeast of Oroville city limits on road to Bangor, *Lewis & Lewis 394.* Eldorado County: Simpson Ranch, Sweetwater Creek, *Brandegee* in 1907. Nevada County: Bear River, western Nevada County, *Hall 10155.* Placer County: 4 miles east of Colfax, *Heller 12746.* Yuba County: Oregon House, *Rose 40396.*

Progenies from the following localities have been studied in the experimental garden. Butte County: Highway 20, 7 miles west of Bangor, *822.* Eldorado County: Highway 49, 1.7 miles south of Coloma P.O., *377.* Highway 49, 3.1 miles south of Pilot Hill, *379.* Placer County: Highway 40, 1.1 miles east of Newcastle, *819.* Yuba County: Stanfield Hill, *158.*

The haploid chromosome number is 8 based on examination of root tips of two individuals from locality *158* and microsporocytes of 12 individuals from localities *158, 379, 819,* and *822.*

Subspecies *brandegeae* is morphologically similar to *C. dudleyana* and, in fact, more closely resembles this species than it does *C. biloba australis.* For example, *Mason*

3270, 5 miles above Auburn, Placer County, includes plants with essentially entire petals which can hardly be distinguished from *C. dudleyana*. But *C. dudleyana* and *C. biloba brandegeae* are separated geographically by a distance of at least 75 miles, and we have been unable, with many attempts, to obtain a hybrid between them. Hybrids between subspecies *brandegeae* and the other two subspecies of *C. biloba* are about 50 per cent fertile (Roberts, 1952).

Relationship.—*Clarkia biloba* is morphologically and cytologically very closely related to the extremely local species *C. lingulata*. In fact, *C. biloba australis* is morphologically distinguishable from *C. lingulata* only on the basis of the bilobed petals. Nevertheless, they differ in chromosome number, and their hybrid is nearly sterile. *Clarkia biloba* is apparently directly ancestral to *C. lingulata* (Lewis, 1954).

Clarkia biloba is likewise morphologically similar and undoubtedly closely related to *C. dudleyana*. In general, they can be distinguished by the conspicuously bilobed petals of the former and the white streaking on the petals of the latter. The two species differ in chromosome number, however, and it is very difficult to obtain hybrids. The only hybrid obtained between them after numerous attempts was between *C. biloba australis* (*346*) and *C. dudleyana* from southern California (*511*). This hybrid grew vigorously but initiated no flowers whatsoever.

Clarkia biloba is unusual in having a haploid chromosome number of 8, which is found in only two other species in the genus, *C. imbricata* and *C. modesta*. The relationship of *C. biloba* to *C. imbricata* is remote, but the relationship to *C. modesta* may be very close. This relationship, however, has not yet been studied cytogenetically inasmuch as we have been unable to obtain hybrids between them. *Clarkia modesta* differs conspicuously from *C. biloba* in having flowers with much smaller, narrow, unlobed petals.

Petals of a presumed natural hybrid between *C. biloba* and *C. concinna* are illustrated by Jepson (1907). We have examined the original material and find no reason to suspect that these aberrant individuals *C. biloba biloba* are a product of interspecific hybridization of any kind.

18. **Clarkia lingulata** Lewis & Lewis, Madroño 12: 35. 1953. (Fig. 17, *a*.)

Erect, as much as 6 dm. tall; stems simple or branched above, puberulent above with short, upwardly curled hairs, sparsely puberulent below; leaf blades linear to narrowly lanceolate, denticulate to entire, 2–6 cm. long, 2–8 mm. broad, glabrate to sparsely puberulent, narrowed into petioles as much as 1.5 cm. long; rachis of the inflorescence recurved in bud, becoming erect as the flowers open, the buds pendulous; hypanthium 1–4 mm. long, not conspicuously colored within, the ring of hairs in the upper third; sepals lanceolate, 7–10 mm. long, 1–1.5 mm. broad, bright pink or purplish, remaining united and deflexed to one side at anthesis; petals oblanceolate, obtuse, entire or minutely notched at the summit, 1–2 cm. long, 5–8 mm. broad, bright pink, sometimes flecked with red; stamens 8, the outer blue with blue pollen, the inner shorter, white to cream with white to cream pollen; stigma 4-lobed, white to reddish-purple, the lobes short; mature style exceeding the stamens; ovary conspicuously 8-ribbed, puberulent, becoming bright green and shining, 5–10 mm. long, sessile or on a pedicel as much as 7 mm. long; mature capsule straight or nearly so, quadrangular, 1–2 cm. long, about 1.5 mm. broad; seeds brown, about 1 mm. long, minutely scaly-puberulent, the crest short, less than 0.1 mm. long.

Type.—Merced River, 0.2 mile west of bridge over the South Fork of the Merced River, Mariposa County, California, *Lewis & Lewis 334*, June 8, 1947 (U.C.L.A.).

Distribution (see fig. 18).—CALIFORNIA. Mariposa County. Known only from two localities along the Merced River. Highway 140, 0.2 mile west of bridge over the South Fork of the Merced River, *Lewis & Lewis 334; 625; Lewis, Lewis, & Roberts 698; 801;* between 7.4 and 7.5 miles east of Bear Creek Bridge, *Lewis & Lewis 629; Lewis, Lewis, & Roberts 703; 796; 797.*

Progenies from both of the known localities have been studied in the experimental garden, and a total of thirty-seven plants have been examined cytologically. All of these had microsporocytes with 9 pairs of chromosomes. No meiotic irregularities have been observed.

Relationship.—This highly restricted species is distinguishable from *Clarkia biloba australis*, which grows adjacent to it, only in the shape of the petal and in chromosome number. Nevertheless, the hybrid between them is highly sterile. Cytological evidence not only suggests that they are extremely closely related but that *C. lingulata* has been derived from *C. biloba* by the addition of a pair of chromosomes. The additional chromosome is homologous to parts of two chromosomes of the normal complement of *C. biloba* (Lewis, 1954). *Clarkia lingulata* is similar in many respects to *C. modesta*, including the shape of the petals, and the two species may be closely related. They are, however, readily distinguished by the larger flowers and strongly 8-ribbed immature capsules of the former.

19. **Clarkia modesta** Jepson, Man. Fl. Pl. Calif. 673. 1925. (Fig. 17, *e.*)

Erect, as much as 7 dm. tall; stems simple or branched, puberulent above with short, upwardly curled hairs, sometimes sparsely so, sparsely puberulent below; leaf blades linear to narrowly lanceolate or elliptic, entire to denticulate, 2–4 cm. long, 2–7 mm. broad, often obtuse, glabrate to sparsely puberulent, narrowed into petioles as much as 10 (15) mm. long; rachis of the inflorescence reflexed in bud, becoming erect as the flowers open, the buds pendulous, hypanthium 1–3 mm. long, not conspicuously colored within, the ring of hairs at the upper margin, sometimes obscure; sepals lanceolate, 8–11 mm. long, 1.5–2 mm. broad, remaining united and deflexed to one side at anthesis; petals oblanceolate to rhomboid, 8–12 mm long, 3–7 mm broad, bright pink, usually with darker flecks toward the base, the claw and veins lighter, subentire to erose-denticulate, the apex usually acute, narrowed at the base into a slender claw about 1 mm long; stamens 8; anthers and filaments white; pollen of the outer anthers blue, the inner cream; stigma white to pink, 4-lobed, the lobes short, sometimes adhering to the longer stamens; style lavender, equaling the stamens at maturity; ovary puberulent, shallowly 8-ribbed, 10–20 mm. long, sessile or on a pedicel as much as 2 (4) mm. long; mature capsule 1.5–3 cm. long, 1–2 mm. broad, subterete; seeds brown, 0.8–1.0 mm. long, scaly tuberculate, particularly on the upper side and raphe, the crest obscure or as much as 0.1 mm. long.

Type. Waltham Creek, San Carlos (Diablo) Range, Fresno County, California, *Jepson 2690* (Jepson Herbarium).

Phaeostoma modestum Heller, Leaf. W. Bot. 2: 221. 1940. *Godetia epilobioides* var. *modesta* Jeps., Fl. Calif. 2: 585. 1936.

Distribution (see fig. 19).—CALIFORNIA Colusa, Contra Costa, Fresno, Glenn, Lake, Madera, Mariposa, Monterey, San Benito, San Luis Obispo, Santa Barbara, Santa Clara, Stanislaus, and Tulare counties. Oak-digger pine woodland, often under shrubs.

Representative specimens.—CALIFORNIA. Fresno County: 6 miles southwest of Auberry, *Constance 2208.* Glenn County: 10 miles east of Alder Springs, *Heller 11458.* Lake County: Houghs Springs, *Abrams 12528.* Madera County: Near Chowchilla River on Mariposa-Raymond Road, *Hoover 3447;* 16 miles northeast of Madera, *Benson 3311.* Mariposa County: Lewis, *Congdon* in 1895. San Benito County: 6 miles east of Paicines, *Howell 12964.* San Luis Obispo County: La Panza Mountains, *Eastwood & Howell 2321.*

Progenies from the following localities have been studied in the experimental garden. Fresno County: Wawona road, 2.6 miles north of road to O'Neals and North Fork, *618;* Los Gatos Creek Road, 4.2 miles east of Fresno County Industrial Camp, *917.* Santa Barbara County: San Rafael Mountains, 1.4 miles north of Davy Brown Camp, *453;* San Rafael Mountains, on road to Davy Brown, 1.4 miles west of Cachuma Guard Station, *638;* San Rafael Mountains, Manzana Camp

Ground, *640*. Santa Clara County: Del Puerto Road to Patterson, 5.8 miles east of junction of Livermore to Mt. Hamilton Road, *509;* Mt. Hamilton to Livermore Road, 0.2 mile west of Westvaco Mine Road, *507*.

The haploid chromosome number is 8, determined from examination of microsporocytes of one or more plants from each of the following populations: *453*, *507*, *509*, *618*, and *638*. The haploid number was earlier reported as 9 (Lewis, 1949). This count may have been in error, or it may be that extra chromosomes occur in some individuals, similar to those known in *C. unguiculata*, *C. gracilis*, *C. williamsonii*, *C. virgata*, and *C. rhomboidea*.

Clarkia modesta is quite uniform for the most part, particularly within a given population. The petals are usually not equally spaced. Frequently, they are grouped into lateral pairs. Petal arrangement, however, may vary on a single plant.

One of the progenies we have grown was from an exceptional population, *618*. This population was essentially uniform except for minor variation with respect to the expression of flecking on the petals. The plants were somewhat more robust than is typical of *C. modesta*, however, and the flowers were larger than usual. The obovate petals were 11–19 mm. long, 6–9 mm. broad, and the claw was not as slender as usual. In size and conformation the flowers appeared intermediate between *C. modesta* and *C. dudleyana*. In other respects, including chromosome number and genetic compatibility, these plants were typical of *C. modesta*.

Relationship.—*Clarkia modesta* is probably most closely related at the diploid level to *C. biloba*. They have the same chromosome number and are morphologically similar in most respects. They differ conspicuously, however, in petal shape, petal size, and the degree of ribbing on the immature capsules. Their cytological relationship aside from chromosome number has not been studied because we have been unable to obtain a hybrid between them after repeated attempts involving plants of both species from several localities.

The relationship of *C. modesta* to *C. dudleyana* may also be close, although they differ in chromosome number. Again we have been unable to obtain a hybrid. One of our populations (*618*) was morphologically intermediate between the two species, but it produced no seeds when crossed with *C. dudleyana*, although it can be easily crossed with other populations of *C. modesta* and produces fertile hybrids with them. The possibility exists that the original relationship between these two species was comparable to that between *C. biloba* and *C. lingulata*. If so, they have subsequently diverged to a greater extent.

Clarkia modesta has been confused with *C. epilobioides* from which it differs in chromosome number and in many morphological traits including the shape, color, and markings of the petals, foliage, and habit. These differences are particularly evident in living plants. These two species, however, have each contributed a genome to the formation of an alloploid species *C. similis*. The intermediate and variable characteristics of this species tend to obscure the differences between the diploid parents.

20. **Clarkia dudleyana** (Abrams) Macbride, Contrib. Gray Herb. n.s. 56: 54. 1918.
(Fig. 17, *f*, *g*.)

Erect, as much as 7 dm. tall; stems simple or branched, puberulent above with short, upwardly curled hairs, sparsely puberulent or glabrate below; leaf blades narrowly lanceolate to lanceolate, denticulate to subentire, 1.5–7 cm long, 3–15 mm. broad, sparsely puberulent to glabrate, narrowed to petioles as much as 1 cm. long; rachis of the inflorescence recurved in bud, becoming erect as the flowers open, the buds pendulous; hypanthium 1–3 mm. long, slender, closed by the ring of hairs at the upper margin, not conspicuously colored within; sepals lanceolate, 10–20 (23) mm. long, 1.5–3 (3.5) mm. broad, remaining united and deflexed to one side at anthesis; petals fan-shaped, entire to erose or emarginate, 10–25 (28) mm. long, lavender-pink, often flecked with red, usually streaked with white, lighter or white below, usually lavender at the summit of the more or less distinct claw; stamens 8; outer anthers lavender or cream with bluish or whitish pollen, the inner cream with cream pollen; filaments lavender; stigma 4-lobed, white to pale pink, the lobes slender; style exceeding the stamens at maturity; ovary sparsely puberulent to glabrate, 5–20 (25) mm. long, sessile or on a pedicel as much as 2 mm. long; immature capsule bright green and shining, strongly 8-ribbed; mature capsule 4- or 8-sided, ribbed, 1–3 cm. long, 2–2.5 mm. broad; seeds brown, about 1 mm. long, minutely scaly-puberulent, the crest less than 0.1 mm. long.

Type.—Based on the type of *Godetia dudleyana* Abrams. Little Santa Anita Canyon at 2,500 ft., Los Angeles County, California, *Abrams 2635* (Stanford).

Godetia dudleyana Abrams, Fl. Los Angeles 267. 1904.
Godetia bottae var. *usitata* Jeps., U.C. Publ. Bot. 2: 332. 1907. Type: San Bernardino, California, *Parish 3672* (isotype examined, Gray Herbarium).

Distribution (see fig. 19).—CALIFORNIA. Fresno, Kern, Los Angeles, Madera, Mariposa, Riverside, San Bernardino, Tulare, and Tuolumne counties. Usually in oak-digger pine woodland and chaparral, occasionally in the lower margin of the montane forest; in southern California often with coastal sage.

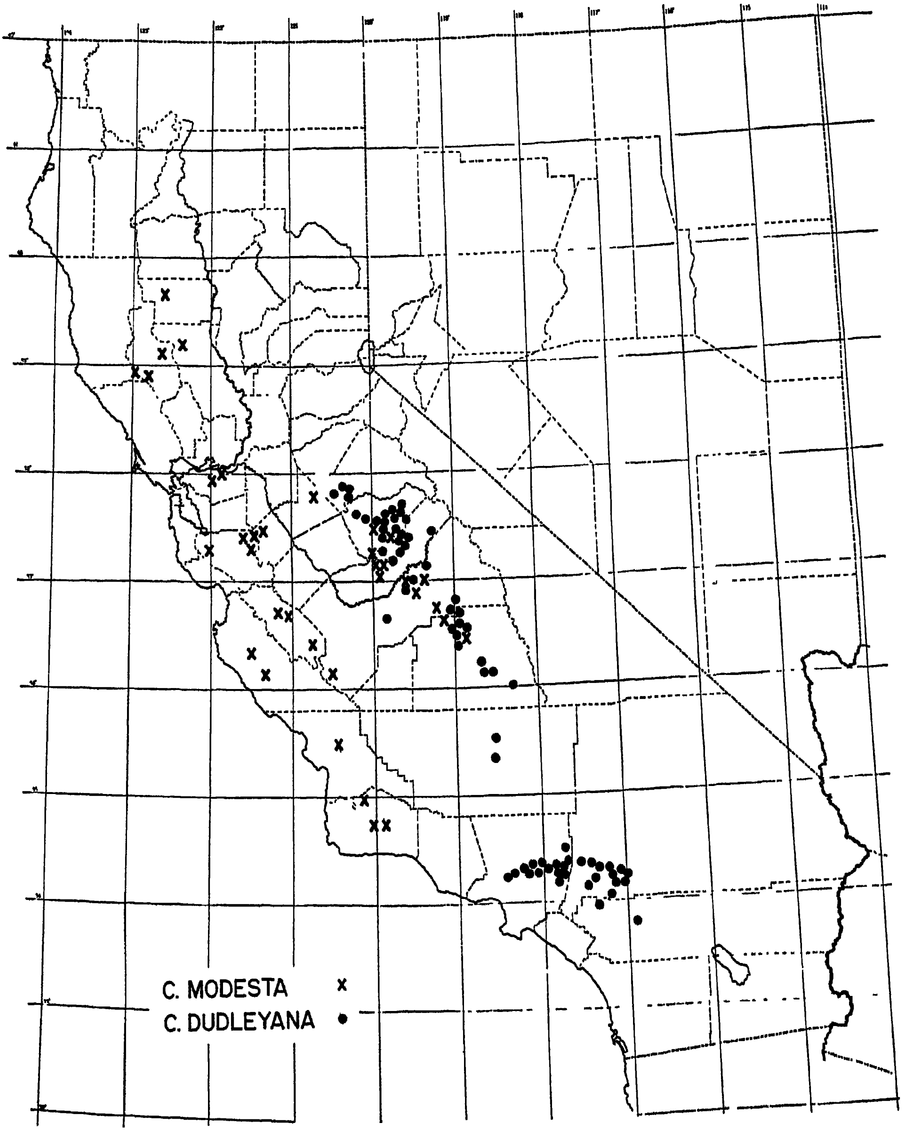
Representative specimens. —CALIFORNIA. Fresno County: Longworth's near North Fork, *Abrams 4967*. Los Angeles County: Evey's Canyon near Claremont, *Hitchcock 45*. Madera County: 2 miles north of O'Neals on Highway 49, *Ferris & Bacigalupi 10410;* northwest end of Bass Lake, *Constance 2348*. Mariposa County: Wawona, *Jepson 8387;* Merced Canyon, *Abrams 4681*. Riverside County: Canyons of the west side of San Jacinto Mountains at 5,000 ft., *Hall 2265*. San Bernardino County: City Creek Canyon, *Munz 11317*. Tulare County: South Fork of Kaweah River, *Culbertson 4495;* open woods of the Middle Tule River, *Purpus 5036*. Tuolumne County: Highway 120, 0.1 mile west of junction of Highway 49 at Moccasin Creek, *Lewis & Lewis 3*.

Progenies from the following localities have been studied in the experimental garden. Fresno County: Miramonte, *159;* 2.7 miles west of Miramonte, *316*. Los Angeles County: San Gabriel Mountains, Tanbark Flats Forest Experiment Station, *511*. Madera County: Highway 41, 0.9 mile south of Coarsegold, *346*. Mariposa County: 7.4 miles south of Chinquapin, *103;* 3.9 miles south of Miami Ranger Station, *126;* 0.2 miles east of Highway 140 on Mormon Bar Road to Mariposa, *340;* Highway 140, 6.4 miles east of South Fork Bridge in Merced Canyon, *634;* Highway 140, 0.2 mile west of bridge over the South Fork of the Merced River, *625*. San Bernardino County: Live Oak Canyon, 3.1 miles from San Timoteo Canyon Road, *54*. Tulare County: Kaweah River to Badger Road, 0.2 mile west of road to M Bar J Ranch, *307*. Tuolumne County: junction of Highway 49 and 120 at Moccasin Creek, *116*.

Clarkia dudleyana has a haploid chromosome number of 9. The following material has been examined: root tips of four plants and microsporocytes of one plant from population *54;* root tips of at least one plant from each of populations *159, 307, 314, 316,* and *511;* microsporocytes from *688A* (Mariposa County, Bower Cave Road). No meiotic irregularities have been observed.

Clarkia dudleyana is a conspicuous annual of early summer in the Sierra Nevada foothills where it frequently carpets large areas. In southern California the species is infrequent and the colonies are usually small and often widely separated.

The material from southern California differs somewhat in flower color and color pattern from the populations in the Sierra Nevada. The southern plants usually have somewhat brighter-colored petals, which frequently do not show the white streaking that characterizes the more northern populations. These differences are



CALIFORNIA—NEVADA

Fig. 19. Distribution of *Clarkia dudleyana* and *C. modesta.*

usually not evident from herbarium material. Nevertheless, these apparently minor differences which do not warrant taxonomic recognition may be associated with strong genetic barriers. Hybrids between individuals from the southern California population *54* (Live Oak Canyon) and each of two Sierran populations *159* and *316* were essentially sterile. However, meiosis in the one hybrid examined (*54* × *159*) showed no irregularities. But all of the southern California populations are apparently not interfertile with one another. For example, the hybrid between *54* and *511* (both from southern California but separated by about 50 miles) is also sterile.

At the same time, even individuals within a population of *C. dudleyana* may be intersterile. For example, certain individuals from population *624* (near Yosemite) set no seeds when crossed to one another reciprocally, although they did set full complements when crossed with other individuals in the same population.

Perhaps the most striking morphological variation in *C. dudleyana* involves the degree of dark flecking on the petals. These flecks are not present on all plants. When they are present, they may be few and scattered near the base or rather abundant. In several populations of *C. dudleyana* from Eshom Valley, Tulare County (*Lewis & Lewis 312*), and in a collection from Yosemite (*Augsbury* in 1922), the flecks on many plants are so numerous that they are confluent. In extreme cases, the resulting petals are completely dark reddish-purple, similar to the color that characterizes *C. williamsonii* f. *incerta* and many populations of *C. purpurea*.

Colonies may also show variation in flower color from nearly white to the typical pale lavender or even a bright pink. Pubescence may also vary conspicuously. For example, a population on the Merced River (*624*) consists of individuals that are glabrous and hence bright-green as well as typical dull-green pubescent individuals. No intermediates occur in this case, which suggests a simple genetic difference. The immature capsules are characteristically bright green and shining, but one occasionally finds individuals or populations with pubescent and rather dull- or light-green capsules. Individuals may also vary with respect to petal shape. Most of the variations indicated are apparently sporadic and are not geographically expressed.

Relationship.—Clarkia dudleyana is morphologically most closely related to *C. modesta* and *C. biloba*, but differs from each in chromosome number. Some herbarium sheets of *C. dudleyana* can scarcely be distinguished from *C. biloba brandegeae*, particularly those variants of *C. dudleyana* in which the petals are emarginate or shallowly bilobed (e.g., Tulare County: Kaweah River Valley, *Coville & Funston 1320;* on grade below switchbacks above Camp Nelson, Sequoia National Forest, *Bacigalupi, Wiggins, & Ferris 2651*). However, *C. dudleyana* and *C. biloba brandegeae* are separated geographically by at least 75 miles, and they differ in chromosome number. In the areas where *C. dudleyana* is sympatric with *C. biloba biloba* and *C. biloba australis*, they are readily distinguished on the basis of petal color as well as petal conformation, for *C. dudleyana* has lighter, white-streaked, essentially entire petals. One hybrid (*C. dudleyana 511* × *C. biloba australis 346*) was obtained after numerous attempts involving many different populations, including all of the subspecies of *C. biloba*. This hybrid grew vigorously but produced no flowers. The close relationship between *C. dudleyana* and *C. modesta* is suggested by the occurrence of morphological intermediates (see *C. modesta*), but we have been unable to obtain a hybrid between the two species. They can be distinguished by petal shape, petal size, and the ribbing of the immature capsules.

Clarkia dudleyana is similar in many respects to *C. cylindrica*, and they might be confused with one another in herbarium collections. As living material, however, the two species differ conspicuously in flower color pattern and are also readily distinguished on the basis of immature capsules, which are relatively short, thick, and deeply 8-ribbed in *C. dudleyana* but slender or clavate and normally 4-grooved in *C. cylindrica*. Furthermore, the ring of hairs is at the top of the hypanthium in *C. dudleyana* and below the upper margin in *C. cylindrica*. All of our attempts to cross these two species have failed. On the other hand, sterile hybrids have been obtained between *C. dudleyana* and species that are much more remotely related (i.e., *C. purpurea* in Section Godetia and *C. unguiculata* in Section Phaeostoma).

SUBSECTION MICRANTHAE SUBSEC. NOV.

Petalis albis, ad 10 mm. longis, sine maculis; stylo stamina aequante; stigmate stamina adhaerens et simul maturans; ovario subtereti.

Petals white, as much as 10 mm long, not flecked; mature stigma not held above the stamens; stigma and stamens maturing more or less simultaneously; anthers adhering to the stigma and depositing pollen directly upon it; immature capsule subterete, not conspicuously ribbed.

Type species.—*C. epilobioides* (Nutt.) Nels. & Macbr.

21. **Clarkia epilobioides** (Nuttall) Nelson & Macbride, Bot. Gaz. 65: 60 *in adnot.* 1918. (Fig. 15, *f.*)

Erect, as much as 7 dm. tall; stems simple or branched, sparsely puberulent above with short, upwardly curled hairs, glabrate to sparsely puberulent below; leaves linear to narrowly lanceolate or narrowly oblanceolate, denticulate to subentire, 15–25 mm. long, 2–4 mm. broad, glabrate to sparsely puberulent, the apex often obtuse, narrowed into petioles as much as 7 mm. long; rachis of the inflorescence reflexed or bent to one side in bud, becoming erect as the flowers open, the buds deflexed or pendulous; hypanthium 0.5–1.5 mm. long, not colored within, the ring of hairs at the upper margin or absent; sepals lanceolate, 6–10 mm. long, 1.5–2 mm. broad, remaining united and deflexed to one side at anthesis or reflexed in pairs, often bright red; petals obovate, rounded to somewhat acute at the apex, entire to erose, 5–10 mm. long, 5–8 mm. broad, white, unmarked, becoming pinkish in age, scarcely if at all clawed; stamens 8; anthers white or cream, often adhering to the stigma; filaments white; stigma white or pale pink, 4-lobed, the lobes short; style the same length as the stamens; ovary 1–2 (3) cm. long, terete or nearly so, sparsely puberulent, on a pedicel 1–4 mm. long; mature capsule slender, 4-sided, the angles rounded, 1–2.5 (3) cm. long, 1 1.5 mm. broad, on a pedicel as much as 11 mm. long, not beaked or the beak less than 1 mm. long; seeds brown, 0.5–1.0 mm. long, somewhat scaly, the crest obscure or as much as 0.1 mm. long.

Type.—Based on the type of *Oenothera epilobioides* Nutt. San Diego, California, *Nuttall* (New York Botanical Garden).

Oenothera epilobioides Nutt. *in* Torr. & Gray, Fl. N. Am. 1: 511. 1840. *Sphaerostigma epilobioides* Walp. Rep. 2: 78. 1843. *Godetia epilobioides* Wats., Bot. Calif. 1: 231. 1876.

Distribution (see fig. 20).—Baja California. Arizona. Gila, Maricopa, Pima, and Pinal counties. California. Kings, Los Angeles, Monterey, Orange, Riverside, San Benito, San Bernardino, San Diego, San Francisco, San Luis Obispo, Santa Barbara, and Ventura counties. Shady sites in oak woodland, occasionally in chaparral; in central Arizona in an area dominated by palo verde and saguaro.

Representative specimens.—Baja California. Between San Antonio del Mar and San Vicente, *Wiggins 4542;* 10 miles north of Rosario, *Wiggins 5229;* San Quintin, *Epling & Stewart* in 1936; near Cataviña, *Harvey 687.* Arizona. Gila County: Roosevelt Lake, *Wiegand & Upton 3874.* Maricopa County: Apache Gap, *Gillespie 5550;* Mormon Flat, *Peebles 3903.* Pima County: Santa Catalina Mountains, *Pringle 269.* Pinal County: Boyce Thompson Arboretum, *Peebles 9182.* California. Los Angeles County: Las Tunas Canyon, *Abrams 1706;* Mandeville Canyon, Santa Monica Mountains, *Clokey & Templeton 4485;* Santa Anita Canyon, *Hitchcock 48;* Avalon, Santa Catalina Island, *Fosberg 947.* Monterey County: Santa Lucia Mountains, *Plaskett 134.* Orange County: Santa Ana River Canyon, *Munz, Street, & Williams 2618.* San Bernardino County: San Bernardino Valley, *Parish 5624;* Little Mountain, *Parish 11215.* San Diego County: Mission Hills, San Diego, *Abrams 3442;* Moro Hill, near Fallbrook, *Abrams 3331;* San Onofre, *Hitchcock* in 1929. San Luis Obispo County: 4.5 miles west of San Luis Obispo on Morro Road, *Keck 2205.* Santa Barbara County: Painted Cave Ranch, San Marcos Road, *Eastwood 43.* Ventura County: Casitas Pass, *Hall 3138.*

Progenies from the following localities have been studied in the experimental garden. Arizona. Maricopa County: Apache Gap, *921.* California. Los Angeles County: North Sepulveda Way, 0.1 mile from Sepulveda Boulevard, *783.* San Diego County: Barrett Canyon, 3.5 miles south of Bar-

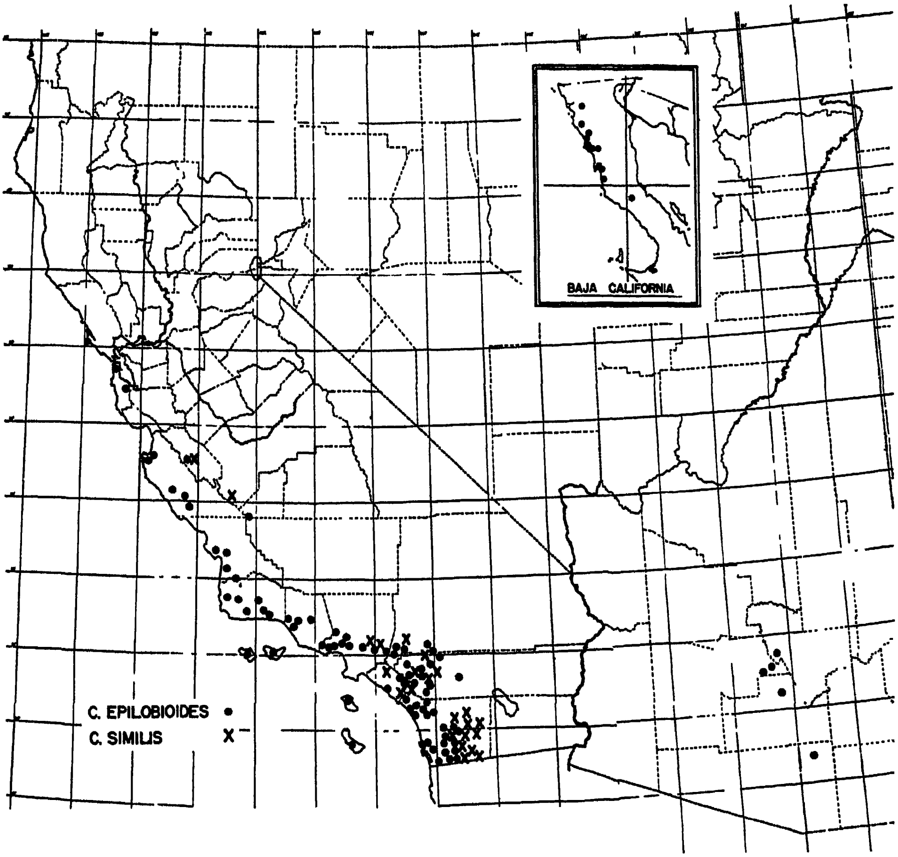


Fig. 20. Distribution of *Clarkia epilobioides* and *C. similis.*

rett Dam, *283;* 1.7 miles north of Barrett Dam, *282;* Highway 94, 1.1 miles west of summit of Potrero Grade, *286*. Santa Barbara County: San Rafael Mountains, 4.6 miles south of Red Rock Mine, *565;* San Rafael Mountains, road to Davy Brown, 1.4 miles west of Cachuma Guard Station, *638A;* San Rafael Mountains, Cachuma Road, 4.2 miles south of Red Rock Mine, *634;* Santa Cruz Island, Pelican Bay, *903*.

The haploid chromosome number is 9, based upon root-tip counts of a plant from population *283* and microsporocytes from *641* and *921*. In addition, microsporocytes were examined from samples collected in the field at Pinnacles National Monument (*787A* and *913*). No meiotic irregularities have been observed.

Clarkia epilobioides is self-pollinated to a very high degree and the populations are correspondingly uniform. Self-pollination is regularly accomplished before the flowers open, and frequently the flowers fail to open although they set a full complement of seeds. Ernst (1953) estimated that at least half of the flowers do not open. One race (*283*) which we have grown for four years in the garden and greenhouse at Los Angeles, for one year in London, England, and under seventeen different conditions of temperature and light in the Earhart Laboratories at the California Institute of Technology has not opened a flower. Outcrossing, however, does undoubtedly occur at least occasionally in most populations.

Relationship.—The relationship of *C. epilobioides* to other diploid species is uncertain. Morphologically it is about as closely related to the species in Subsection Peripetasma as to those in Lautiflorae. *Clarkia epilobioides* resembles *C. modesta* in having small flowers, but examination of microsporocytes of their hybrid indicates that their genomes are so dissimilar that they ordinarily do not form any pairs at meiotic first metaphase. Such a hybrid has, however, given rise to the alloploid species *C. similis* (Section Peripetasma, Subsection Prognatae). *Clarkia epilobioides* has also hybridized at some time in the past with *C. unguiculata* (Section Phaeostoma) to produce the alloploid species *C. delicata* (Section Connubium).

SUBSECTION PROGNATAE SUBSEC. NOV.

Petalis pallidis, concoloribus, purpureo-punctulatis, 6-12 mm. longis; antheris plerumque liberis; stylo stamina aequante; stigmate stamina simul maturans; ovario 8-canaliculato.

Petals pale pink to nearly white, flecked with purple in the lower half, not differentiated into distinct zones of color, 6–12 mm long; anthers usually free, maturing with the stigma; stigma not held above the stamens; immature capsule 8-striate.

Type species.—*C. similis* Lewis & Ernst.

This subsection is of alloploid origin derived from species in subsections Lautiflorae and Micranthae.

22. **Clarkia similis** Lewis & Ernst, Madroño 12: 89. 1953. (Fig. 15, *e*.)

Erect herb as much as 9 dm. tall; stems simple or branched, puberulent above with short, upwardly curled hairs, sometimes sparsely so, sparsely puberulent to glabrate below; leaf blades narrowly lanceolate to lanceolate-elliptic, subentire to denticulate, 2-4 cm. long, 3–8 mm. broad, the apex often obtuse, glabrate to sparsely puberulent, narrowed into petioles as much as 8 mm. long; rachis of the inflorescence reflexed in bud, becoming erect as the flowers open; buds pendulous; hypanthium 1.5–2 mm. long, puberulent, the ring of hairs at the upper margin; sepals lanceolate, 6–10 mm. long, about 1.5 mm. broad; petals 6–12 mm. long, 3–6 mm. broad, oblanceolate to rhomboid or obovate, subentire, the apex rounded, acute or undulate, narrowed at the base to a slender claw about 1 mm. long, nearly white to light pink shading to white below, flecked with purple in the lower half; stamens 8, in two series, the outer longer, both series with yellowish pollen; anthers usually free from the stigma; stigma whitish with 4 short lobes; style pinkish, equaling the stamens; ovary subterete, 8-striate, 1.5–2.5 cm. long, sessile or on a pedicel as much as 3 mm. long; mature capsule quadrangular, 1.5–3 cm. long, 1-1.5 mm. broad; seeds brown, about 1 mm. long, scaly tuberculate, particularly on the upper side and raphe, the crest obscure or as much as 0.1 mm. long.

Type.—7.6 miles west of Ramona, San Diego County, California, April 22, 1951, *Lewis, Lewis, Ernst, and Mathias 773* (U.C.L A).

Distribution (see fig. 20).—CALIFORNIA. Fresno, Los Angeles, Orange, Riverside, San Benito, San Bernardino, and San Diego counties. Probably also in northern Baja California. In oak woodland or the margin of chaparral.

Specimens examined.—CALIFORNIA. Fresno County. 12 miles from Coalinga on the road to Parkfield, *Eastwood & Howell* in 1938. Los Angeles County: Wolfskill Canyon off San Dimas Canyon, *Ewan 2376;* East Fork of Big Santa Anita Canyon, San Gabriel Mountains, *Howell 3777.* Orange County: Santa Ana Mountains, San Juan Canyon, 0.2 mile west of Upper San Juan Camp Ground, *Lewis, Lewis, Ernst, & Mathias 769;* Santa Ana, *Smith* in 1903. Riverside County: Cranston Ranger Station, San Jacinto Canyon, without collector in 1951; Banning, *Gilman 23;* 10 miles south of Hemet, *Munz 10816;* Elsinore, *McClatchie* in 1892; San Juan Mountains, San Juan Canyon, *Winblad* in 1941. San Benito County: Pinnacles, *Howell 12936.* San Bernardino County: Arrowhead Hot Springs, *Grant 6617;* mountain slopes, Clear Creek Road, *Parish* in 1891; San Diego County: *Cooper 531; Henshaw 27,* San Diego, *T.S. Brandegee* in 1903; top of the grade, Descanso, *K. Brandegee* in 1906; Fallbrook, *Cleveland* in 1981 (*sic!*); Ramona, *Collins & Kempton 159;* Warner's Springs, *Coombs* in 1911; Tia Juana, *Eastwood 2929;* South Fork Featherstone Creek, Barona Valley, *Gander*

4015; 3 miles south of Deluz, *Gander 5793;* Burn between Campo and Canyon City, *Gander 9346;* 5 miles south of Mesa Grande, on Black Canyon Road, *Gander 11356;* San Diego, *Grant 88;* Potrero Grade, *Gray* in 1925; San Ysabel, *Henshaw* in 1893, San Felipe Creek, *Keck and McCully 111;* 7.6 miles west of Ramona, *Lewis, Lewis, Ernst, & Mathias 773* (type); Banner Grade below Julian *Munz & Hitchcock 11363.*

Progenies from the following localities have been studied in the experimental garden San Diego County: 0.5 mile east of Cleveland National Forest boundary on road to Barrett Lake, *277;* 2 miles north of Barrett Dam, *280;* between Campo and Potrero between culverts D8.07 and D8.14, *288A*. San Benito County: High Peaks Trail, Pinnacles National Monument, *787*.

The haploid chromosome number is 17, based upon examination of microsporocytes of one or more plants from localities *277*, *280*, *288A*, and *787*. In addition, buds were examined from a population near Upper San Juan Camp Ground, Santa Ana Mountains, Orange County, *769*.

Clarkia similis shows considerable variation in flower color. The petals are usually pale pink, but those from the Pinnacles National Monument (*787*) are essentially white. The petals of all of the collections we have seen, however, have been flecked in the lower half. The shape of the petals varies from rhomboid to obovate, but they are usually broader than those of *C. modesta* and narrower than those of *C. epilobioides*. The petals are often unequally arranged and tend to be grouped into lateral pairs, although not to the extent commonly found in *C. modesta.*

Relationship.—*Clarkia similis* is an allopoid species which combines genomes derived from *C. modesta* (Section Peripetasma, Subsection Lautiflorae) and *C. epilobioides* (Section Peripetasma, Subsection Micranthae). The hybrid between the two diploids is morphologically comparable to *C. similis* (Ernst, 1953) and the cytological behavior in the microsporocytes of hybrids between *C. similis*, and each of the diploids leaves no doubt as to its origin. *Clarkia similis* is not always easy to distinguish from its diploid parents, particularly in herbarium collections. It is perhaps most readily distinguished from *C. epilobioides* by having somewhat narrower pale-pink petals which are flecked with purple. *Clarkia similis* differs most conspicuously from *C. modesta* in having broader and paler petals.

SECTION FIBULA SEC. NOV.

Herbae erectae, caulibus glabris et glaucis; inflorescentium axe erecto; calycis tubo obconico, 2–3 mm. longo; annulo pilorum in apice posito; calycis limbo sub anthesi connato et declinato; petalis flabelliformis, 1–3 cm. longis, punctulatis, unguiculis apprime brevis; staminibus 8, circulis duo dissimilibus; antheris obtusis quam filamenta brevioribus; filamentis gracilibus; ovario tereti vel 4-canaliculato.

Erect herbs; stems glabrous and glaucous; rachis of the inflorescence erect; buds deflexed, becoming erect as the flowers open; hypanthium obconical, 2–3 mm. long, the ring of hairs at the apex; sepals remaining united and deflexed to one side at anthesis; petals fan-shaped, 1–3 cm. long, flecked, the claw very short or obscure; stamens 8, in two series, the inner usually with cream-colored pollen, the outer at first divergent, the pollen blue; anthers obtuse, shorter than the filaments; filaments slender; immature capsule terete or 4-grooved.

Type species.—*C. deflexa* (Jeps.) Lewis & Lewis.

Relationship.—This section consists of a single diploid species, *C. deflexa*, which combines morphological features of Section Phaeostoma with those of Section Peripetasma. It does not seem to be closely related to any other section. Section Fibula is like Phaeostoma in having glabrous and glaucous stems, which are erect to the summit with only the buds deflexed. The leaves are also like those of Phaeostoma. On the other hand, the flowers are very similar to those of Peripetasma. The petals of both are fan-shaped and form a cuplike corolla; the color of the stamens and pollen, together with the flecking on the petals is also alike in both. Furthermore, the ovary of *C. bottae* (Peripetasma) is very similar to that of *C. deflexa*. The combination of characters found in Section Fibula suggests that it may possibly have been derived from hybridization between Phaeostoma and Peripetasma (see *C. deflexa*).

23. **Clarkia deflexa** (Jepson) Lewis & Lewis, Madroño 12: 33. 1953.

(Fig. 15, *g*, *h*, *i*.)

Erect, as much as a meter tall; stems stout, glabrous and glaucous, rarely puberulent; leaf blades narrowly lanceolate to lanceolate, denticulate to subentire, 3–7 (10) cm. long, 5–15 (20) mm. broad, sparsely puberulent, narrowed into petioles as much as 5 mm. long; rachis of the inflorescence erect; buds deflexed, becoming erect as the flowers open; hypanthium 2–3 mm. long, not conspicuously colored within, the copius ring of hairs at the apex; sepals lanceolate, 10–20 mm. long, 3–4 mm. broad, remaining united and deflexed to one side at anthesis; petals fan-shaped, entire or erose, 1–3 cm. long, pale lavender to pinkish-lavender, often shading to nearly white near the base, scarcely clawed, characteristically red-flecked; stamens 8, the inner shorter, erect, with cream or bluish-gray pollen, the outer at first divergent, becoming erect as the blue pollen is shed; anthers obtuse, those of the inner stamens yellowish, usually flecked with red, the outer lavender; filaments lavender, longer than the anthers; stigma 4-lobed, the lobes broad, at first pink, usually white when expanded; style lavender, exceeding the stamens at maturity; ovary puberulent, subterete, obscurely 4-grooved, 10-30 mm. long, sessile or on a pedicel as much as 30 mm. long; mature capsule straight or nearly so, scarcely if at all beaked, quadrangular to subterete, 3–4 cm. long, 2 mm. broad; seeds brown or gray, 1.2–1.8 mm. long, scaly, the crest inconspicuous or as much as 0 2 mm. long.

Type.—Based on the type of *Godetia deflexa* Jepson. Sandy plains of Los Angeles, *W. Lobb* in 1854 (Kew).

Godetia deflexa Jeps , U.C. Publ. Bot. 2: 332. 1907. *Godetia bottae* var. *deflexa* Hitch., Bot. Gaz. 89: 355. 1930.

Distribution (see fig 21).—CALIFORNIA. Los Angeles, Monterey, Orange, Riverside, San Bernardino, San Diego, San Luis Obispo, Santa Barbara, and Ventura counties. Openings in the chaparral or woodland in the coastal mountains.

Representative specimens.—CALIFORNIA. Los Angeles County: Mandeville Canyon, *Clokey & Templeton 4534;* Elysian Park, *Brandegee & Braunton 124.* Orange County: mouth of Santa Ana Canyon, *Hitchcock 49.* Riverside County: Santa Ana Canyon, 8 miles west of Prado, *Hitchcock 57.* San Diego County: Franklin Canyon, *Thackeray 320.* San Luis Obispo County: Santa Lucia Mountains, Santa Rosa Creek 1 3 miles east of Mammoth Rock School on Cambria-Templeton Road, *Wolf 10984.* Santa Barbara County: San Marcos Pass, Painted Cave Ranch, *Eastwood 42;* Gaviota, *Elmer 2470.* Ventura County: Conejo Grade, *Abrams 6550.*

Progenies from the following localities have been studied in the experimental garden. Los Angeles County: Santa Monica Mountains, junction of Sepulveda Boulevard and South Sepulveda Way, *27;* 0.6 mile from Sepulveda Boulevard on North Sepulveda Way, *30;* 0 3 mile west of fire station on Mulholland Drive, *31;* 0.7 mile west of fire station on Mulholland Drive, *32;* intersection of Mulholland Drive and Alhama Drive, *34;* 0.4 mile north of Latigo Canyon Road on Decker Road, *443* Monterey County: Santa Lucia Mountains, *161;* road to Pleyto near intersection with Bradley-Jolon Road, *493.* Orange County: Santa Ana Canyon, Rancho Santa Ana, *166.* San Luis Obispo County: California Polytechnic School Canyon, *170.* Santa Barbara County: 0.2 mile west of entrance to Figueroa Camp, Figueroa Mountain, *452;* 1.4 miles south of Davy Brown Camp, San Rafael Mountains, *456;* Gaviota Pass, *457;* 12.5 miles west of Las Cruces Inn on road to Lompoc, *463;* Las Cruces–Lompoc Road, 2.1 miles east of road to Jalama, *465;* 0 4 mile south of Las Cruces–Lompoc Road on road to Jalama, *466.*

Clarkia deflexa shows considerable variation, particularly from population to population and to some extent regionally. The most conspicuous morphological variation is seen in the habit of the plant and the conformation and coloring of the co-

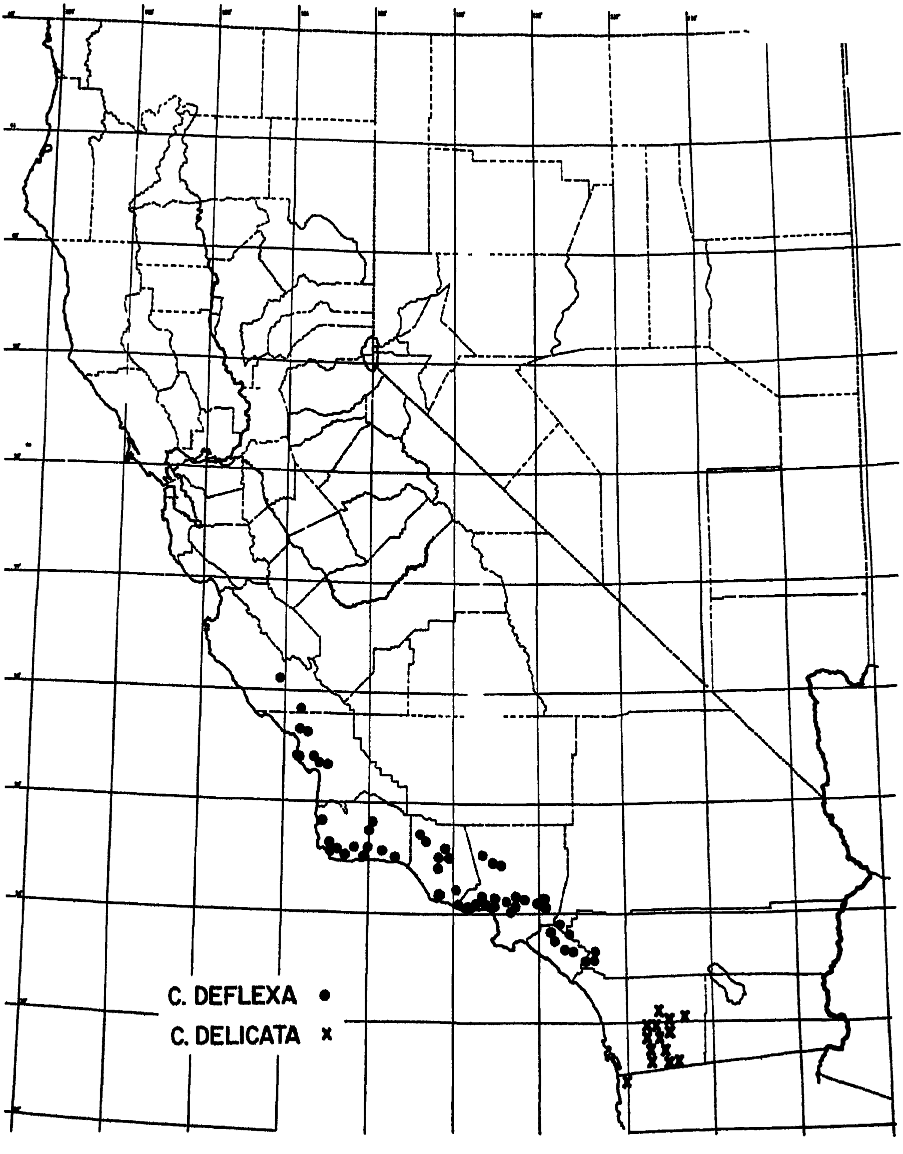


Fig. 21. Distribution of *Clarkia deflexa* and *C. delicata.*

rolla. These differences are most conspicuous when progenies are grown under uniform conditions in the experimental garden and are difficult or impossible to detect in herbarium material. Plants from the Santa Monica and Santa Ana mountains tend to be extremely robust with coarse stems, whereas those from the San Rafael and Santa Lucia mountains are shorter, more slender, and more openly branched. The stems of *C. deflexa* are characteristically straight with deflexed buds. One population, however, *468*, near the center of distribution in Santa Barbara County, has stems which are recurved at the very tip. They do not, however, have the wilted look of the recurved stem typical of Section Peripetasma. The stems of *C. deflexa* are characteristically glabrous and glaucous, but individuals and populations do occur which show a few scattered hairs in the upper parts. This is particularly true of populations from Santa Barbara County and farther north. The corolla of *C. deflexa* is bowl-shaped in most southern California populations, whereas those from the San Rafael and Santa Lucia mountains are much more shallow. Furthermore, the petals of the latter populations also tend to be lighter colored with the lower half of the petal white or yellowish as opposed to the more or less uniform lavender-pink of the southern material. At the same time, the populations with the brightest flowers (*170*, *457*) have come from San Luis Obispo and Gaviota Pass, respectively, the former in the northern part of the geographical range of the species, the latter about the middle. The red flecking which is characteristic of this species is extremely variable from individual to individual and from one population to another but is seldom completely absent.

Two or more subspecies might be recognized on the basis of the material we have grown in the garden. Populations from the extreme northern and southern limits of distribution are quite different morphologically. However, the morphological traits upon which intraspecific taxa might be based have not yet been studied in detail and are not evident from herbarium material. Consequently, we are deferring any formal recognition of such taxa.

The fertility relationships within the species seem to show very little correlation with the morphological differentiation. A large number of crosses indicate that some interpopulational hybrids are fully fertile and produce a vigorous and fertile F_2; others result in a degenerate or sterile F_2. Still other interpopulational hybrids are sterile or have a greatly reduced fertility, whereas individuals from one population could not be crossed with others (Lewis, 1953*a*). But one cannot predict with any degree of certainty on the basis of morphological similarities or geographical proximity what the fertility relationship between any two colonies will be.

The haploid chromosome number is 9, based upon examination of microsporocytes or root tips of one or more individuals from each of the sixteen populations we have grown, except number *30*. The entire range of distribution has been sampled and in all cases the chromosomes were relatively large, as reported by Håkansson (1941*b*). No meiotic irregularities have been observed in field samples or in interpopulational hybrids (e.g., *170* times each of the following: *27*, *32*, *34*, and *161*). Chromosome studies of *Godetia bottae* by Chittenden (1928) and Håkansson (1925) are referable to *C. deflexa* (see Appendix II).

Relationship.—Clarkia deflexa is morphologically intermediate between Section Phaeostoma and Section Peripetasma with no unique features of its own. It has the vegetative characteristics which are otherwise unique to Section Phaeostoma (and the directly related alloploid Section Connubium). This includes gross habit, glabrous and glaucous stems, erect leader with nodding buds, together with leaf shape and texture. Before the first flower opens one would certainly place *C. deflexa* in Phaeostoma. The flowers, however, are more like those of Peripetasma. The petals are fan- or shield-shaped rather than elaborately incised or clawed as is characteristic of Phaeostoma. The petals are flecked, a characteristic of Peripetasma, but the flecks are surrounded by a margin of white similar to the spots in *C. xantiana* (Phaeostoma). The hypanthium, ovary, capsules, and stamens of *C. deflexa* are scarcely to be distinguished from those of *C. bottae* (Peripetasma). On the other hand, the chromosomes of *C. deflexa* are more comparable in size to those of Phaeostoma. At the same time, characteristics suggestive of Peripetasma, for example, a bent leader and puberulence, appear as occasional variants in *C. deflexa*.

The geographical distribution of *C. deflexa* overlaps that of both Peripetasma and Phaeostoma. One finds *C. deflexa* growing with *C. cylindrica* on the one hand and with *C. unguiculata* on the other. Sterile hybrids between *C. deflexa* and most of the species of Peripetasma have been obtained (see table 3). In all of these hybrids, the large chromosomes of *C. deflexa* could readily be distinguished from those of the other species by their size. The species of Peripetasma have much smaller chromosomes than *C. deflexa*, as was reported by Håkansson (1943*b*) for the hybrid between *C. deflexa* and *C. bottae*. We have not yet been able to obtain a hybrid between *C. deflexa* and a species of Phaeostoma. The capacity to hybridize, however, is not necessarily an indication of degree of relationship. For example, as indicated above, we have been unable to cross one population of *C. deflexa* with other populations of the same morphological species. On the other hand, Chittenden (1928) obtained a hybrid between *C. deflexa* and *C. tenella* (Section Godetia) which can scarcely be considered closely related on any grounds. Furthermore, when this hybrid was backcrossed to *C. deflexa*, five individuals were obtained which possessed two complete or essentially complete sets of *deflexa* chromosomes plus various numbers of *C. tenella* chromosomes which could be distinguished by their smaller size. Meiosis was apparently not studied in either the original hybrid or the derivatives.

The intermediate nature of *C. deflexa* with respect to the two very different sections Phaeostoma and Peripetasma can be explained in any one of three ways. The three groups may have developed independently from a common ancestral stock. But all other groups in the same genus which might be inferred to have developed independently from such a stock have each acquired several unique traits of their own, whereas not a single unique trait appears in *C. deflexa*. *Clarkia deflexa* might be considered the parental stock from which both Phaeostoma and Peripetasma have arisen. *C. deflexa*, however, has a derived haploid chromosome number of 9 rather than 8 or the original basic number of 7 (Lewis, 1953*b*). At the same time, genomes of 8 do occur in Peripetasma. A third possibility is that *C. deflexa* is of hybrid origin. We have obtained hybrids between *C. dudleyana* (Peripetasma) and *C. unguiculata* (Phaeostoma). These produced no seeds when self-pollinated. No attempts were made, however, to backcross the hybrids to either parent. The chromosomes of this hybrid formed from 3 to 8 bivalents at meiotic first metaphase with a mean of about 6. This suggests that sections Phaeostoma and Peripetasma may be more closely related than their morphological differences indicate, and that *C. deflexa* could have been derived from such an intersectional hybrid.

SECTION CONNUBIUM SEC. NOV.

Herbae erectae; caulibus glaucis, glabris vel pubescentibus; inflorescentium axe erecto; calycis tubo plus minusve 2 mm. longo; annulo pilorum in apice posito; calycis limbo sub anthesi connato et declinato; petalis spathulatis vel obovatis, plus minusve 1 cm. longis; staminibus 8, circulis duo dissimilibus; antheris obtusis; filamentis gracilibus; ovario 8-canaliculato.

Erect herbs; stems glabrate or puberulent, glaucous; rachis of the inflorescence erect; buds deflexed, becoming erect as the flowers open; hypanthium about 2 mm. long, the ring of hairs at the upper margin; sepals remaining united and deflexed to one side at anthesis; petals spatulate or obovate, about 1 cm. long, the limb narrowed to a tapering claw; stamens 8, in two unlike series; anthers obtuse; filaments slender; immature capsule 8-grooved.

Type species.—C. delicata (Abrams) Nels. & Macbr.

Relationship.—This section is of alloploid origin and combines genomes derived from Section Phaeostoma and Section Peripetasma.

24. **Clarkia delicata** (Abrams) Nelson & Macbride, Bot. Gaz. 65: 60. 1918. (Fig. 22, *g, h.*)

Erect, as much as 7 dm tall; stems simple or branched, glabrate and glaucous above, glabrate to minutely puberulent below; leaf blades lanceolate to ovate, sometimes elliptic, 1.5–4 cm. long, 4–15 mm. broad, serrate to denticulate or the upper leaves entire, glabrous or essentially so, narrowed into petioles as much as 10 (13) mm. long; rachis of the inflorescence erect; buds deflexed, becoming erect as the flowers open; hypanthium about 2 mm. long, not conspicuously colored within, the ring of hairs at the upper margin; sepals lanceolate, 6–9 mm. long, about 2 mm. broad, remaining united and deflexed to one side at anthesis; petals spatulate to obovate, subentire, 8–12 mm. long, 4–8 mm. broad, bright rose-lavender to pale pink, lighter in the lower half, narrowed into a tapering claw; stamens 8, the outer bright orange-red, sometimes paler, the inner shorter, cream; pollen light yellow; stigma white, prominently 4-lobed, the lobes about 1 mm. long; style pale, equaling the stamens at maturity; ovary sparsely puberulent, 8-grooved, 1–2 cm. long, sessile or on a short pedicel less than 2 mm. long; mature capsule quadrangular, 1.5–3.5 cm. long, about 2 mm. broad; seeds brown, 1–1.5 mm. long, tuberculate on the upper side and raphe, the crest obscure.

Type.—Based on the type of *Godetia delicata* Abrams. Shady slope between Campo and Potrero, San Diego County, California, *Abrams 3710* (Stanford).

Godetia delicata Abrams, Bull. Torrey Bot. Club 32: 539. 1905.

Distribution (see fig. 21).—BAJA CALIFORNIA. CALIFORNIA. San Diego County. Usually in oak woodland.

Specimens examined. BAJA CALIFORNIA. Tijuana, *Orcutt* in 1885. CALIFORNIA. San Diego County: 7 miles west of Campo, *Munz 12625;* Barrett Dam, *Munz 8020* (in part); Campo, *Epling & Lewis* in 1940; Potrero Grade, *Munz 9496a;* Harbison Canyon, *Gander 1180;* 5 miles south of Mesa Grande on Black Canyon Road, *Gander 2008;* Lyons Valley, *Gander 3627;* Descanso, *K. Brandegee* in 1906 (in part); Descanso, *T. S. Brandegee* in 1906; Ramona Ranch, *T. S. Brandegee* in 1906; Chariot Canyon, San Felipe Creek, *Keck & McCully 104;* 5.5 miles south of Ramona, *Wiggins 2446* (in part); San Ysabel, *Henshaw* in 1893 (in part); Witch Creek, *Alderson 724.*

Progenies from the following localities have been studied in the experimental garden. San Diego County: Road to Barrett Lake, 0.5 mile east of Cleveland National Forest boundary, *276;* Barrett Canyon, 3.5 miles south of Barrett Dam, *284;* Potrero Grade, 1.1 miles west of Summit, *287;* between Campo and Potrero, between culverts D8.07 and D8.14, *288.*

The haploid chromosome number is 18, determined from examination of microsporocytes of one or more individuals from each of collections *276* and *287*. The haploid number was previously reported as 17 (Lewis, 1949), based upon material which we now refer to *C. similis*. No meiotic irregularities have been observed.

Clarkia delicata is relatively uniform throughout its rather restricted distribution. It shows only minor variation in petal and leaf conformation and in flower color.

Relationship.—Clarkia delicata is an allotetraploid species derived from *C. unguiculata* and *C. epilobioides* (Ernst, 1953).

SECTION PHAEOSTOMA SEC. NOV.

Erect herbs; stems glabrous and glaucous; rachis of the inflorescence erect; buds deflexed, becoming erect as the flowers open; hypanthium campanulate or obconical, 2–5 mm. long, closed by a copius band of hairs; sepals remaining united and deflexed to one side at anthesis; limb of the petals entire and shorter than the slender claw, or the petals bilobed with a subulate tooth in the sinus; stamens 8, in two similar or dissimilar series, the outer often larger, at first divergent, becoming

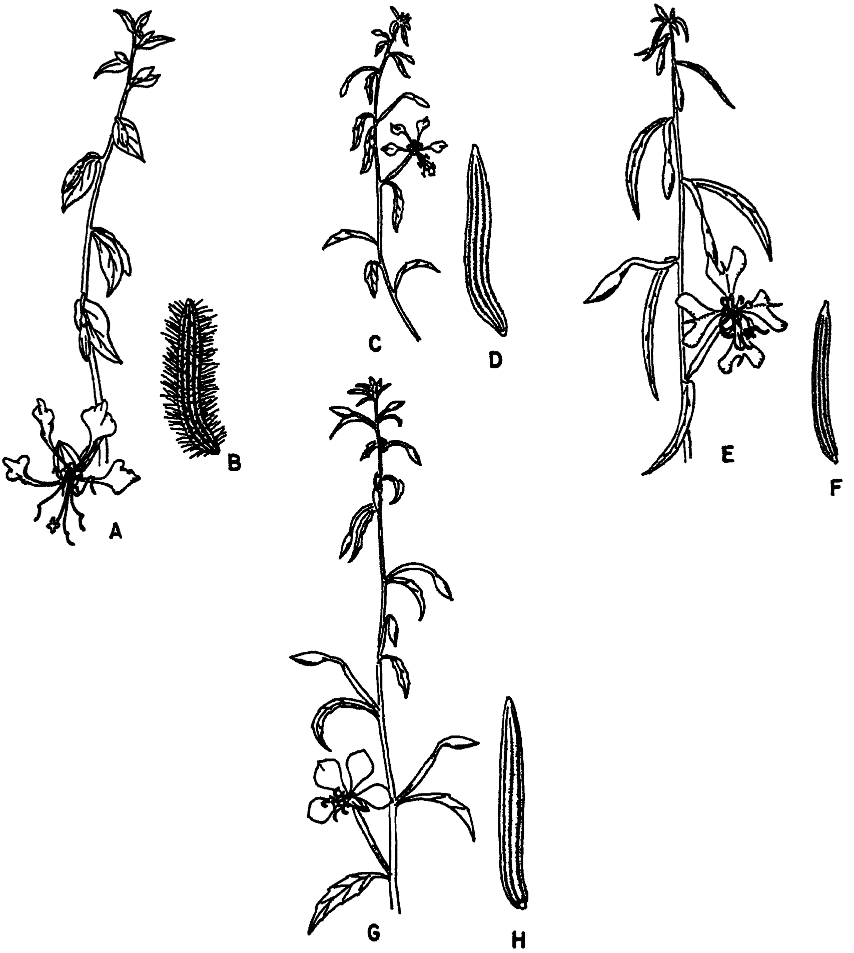


Fig. 22. *a*, *Clarkia unguiculata*, inflorescence × ½; *b*, capsule × 1; *c*, *C. exilis*, inflorescence × ½; *d*, capsule × 1; *e*, *C. xantiana*, inflorescence × ½, *f*, capsule × 1; *g*, *C. delicata*, inflorescence × ½; *h*, capsule × 1.

erect; anthers obtuse, shorter than the filaments; filaments slender, immature capsule 8-grooved or ribbed.

Type species.—*C. unguiculata* Lindl.

Phaeostoma, as a genus, Spach, Hist. Veg Phan. 4: 392. 1835; as a subgenus, Munz and Hitchcock, Bull. Torrey Bot. Club 56: 187. 1929.

Relationship.—Section Phaeostoma is morphologically most closely related at the diploid level to Section Fibula. Close morphological similarity is found in all of the vegetative traits and many of the flower characteristics of the two sections. They differ, however, in the conformation of the petals, hypanthium, and ovary. Both sections have a basic chromosome number of 9. No close relationship of Phaeostoma to other sections is evident except to the polyploid Section Connubium, which combines genomes from sections Phaeostoma and Peripetasma. Phaeostoma is, therefore, linked to Section Peripetasma through polyploidy and perhaps also at the diploid level by way of Section Fibula (see Section Fibula). Phaeostoma in earlier treatments has been combined taxonomically with the species we have assigned to Section Myxocarpa. These two sections, however, have very few morphological characteristics in common aside from those traits which are typical of the genus as a whole. Even petal shape, which in the past has been considered of particular significance as an indicator of relationships in *Clarkia*, is consistently different between these two sections. Furthermore, the chromosome complements of the two sections in no way suggest a close relationship.

25. **Clarkia unguiculata** Lindley, Bot. Reg. t. 1981. 1837. (Fig. 22, *a*, *b*.)

Erect, as much as a meter tall; stems simple or branched, glabrous and glaucous throughout; leaf blades lanceolate to ovate or elliptic, entire to denticulate, 1–6 cm. long, 5–20 mm. broad, narrowed to petioles as much as 1 cm. long; rachis of the inflorescence erect; buds deflexed, becoming erect as the flowers open; hypanthium campanulate to obconical, 2–5 mm. long, with a band of hairs 1–2 mm. wide in the upper half, this band often more or less confluent with the ring of hairs at the upper margin, the hairs white to dark red; sepals oblanceolate or spatulate, remaining united and deflexed to one side at anthesis, 10–16 mm. long, 2–4 mm. broad, dark red to green, glabrate to densely pilose with red or white hairs as much as 3 mm. long, sometimes with short, curled, eglandular or short, spreading, glandular hairs, the various sorts occurring in any combination; petals 10–20 mm. long, 5–15 mm. broad, lavender-pink to salmon or purplish to dark reddish-purple, occasionally white, sometimes with a darker spot at the base of the limb or claw or both; limb of the petal deltoid to rhomboid, sometimes suborbicular, tapering abruptly into a slender claw equal to or exceeding the limb; stamens 8; anthers of the outer stamens reddish-orange to dull red with copious bluish-gray pollen, the inner lighter in color or white with bluish-gray or white pollen; filaments reddish-purple to white; stigma white with 4 rounded lobes; style lavender to white, exceeding the stamens at maturity; ovary 8-ribbed, 10–20 mm. long, glabrate or pubescent or puberulent, the hairs various as on the sepals, sessile or on a pedicel as much as 3 mm. long; mature capsule straight or curved, subterete to quadrangular, 15–30 mm. long, 2–3 mm. broad, scarcely if at all beaked; seeds brown, 1–1.5 mm. long, tuberculate, the crest minute.

Type.—California. *Douglas* (Lindley Herbarium).

Phaeostoma unguiculata Lilja, Fl. Sverig. Suppl. 25. 1840.

Clarkia elegans Dougl. *in* Lindl., Bot. Reg. 19 t. 1575. 1833. Type: California, *Douglas* (Lindley Herbarium). (Not *C. elegans* Poir., 1817.) *Phaeostoma douglasii* Spach, Nouv. Ann. Mus. Paris III 4: 395. 1835 (in part). *Phaeostoma elegans*, Lilja, Fl. Sverig. Suppl. 25. 1840. *Oenothera elegans*, Lév., Monog. Onoth. 289. 1908.

Clarkia eiseniana Kellogg, Proc. Calif. Acad. 7: 94. 1877. Type: near Fresno, California, *Eisen* (Cal. Acad.).

The name *Clarkia elegans* Douglas, by which this species has been known for over a century, must be rejected inasmuch as it is a later homonym, *Clarkia elegans* Poiret having been published earlier (Dict. Sc. Nat. 9: 355. 1817). *Clarkia elegans* Poiret is a simple name change of *Clarkia pulchella* Pursh, based explicitly upon the latter species. Inasmuch as Poiret writes "Clarckia elegante: Clarckia pulchella Pursh" in Lamark's Encyclopedia Supplement (1817), it seems probable that *C. elegans* Poiret published the same year is but a Latin translation of the French common name for *C. pulchella*. Nevertheless, *C. elegans* Poiret is validly published and hence must be taken into account for considerations of priority.[2]

Distribution (see fig. 23).—CALIFORNIA. Alameda, Amador, Butte, Calaveras, Contra Costa, Eldorado, Fresno, Kern, Kings, Lake, Los Angeles, Madera, Marin, Mariposa, Mendocino, Monterey, Napa, Placer, Plumas, Sacramento, San Benito, San Bernardino, San Diego, San Joaquin, San Luis Obispo, San Mateo, Santa Barbara, Santa Clara, Santa Cruz, Solano, Sonoma, Stanislaus,

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[2] We are indebted to H. W. Rickett for a clarification of the nomenclatural disposition of this curious situation.

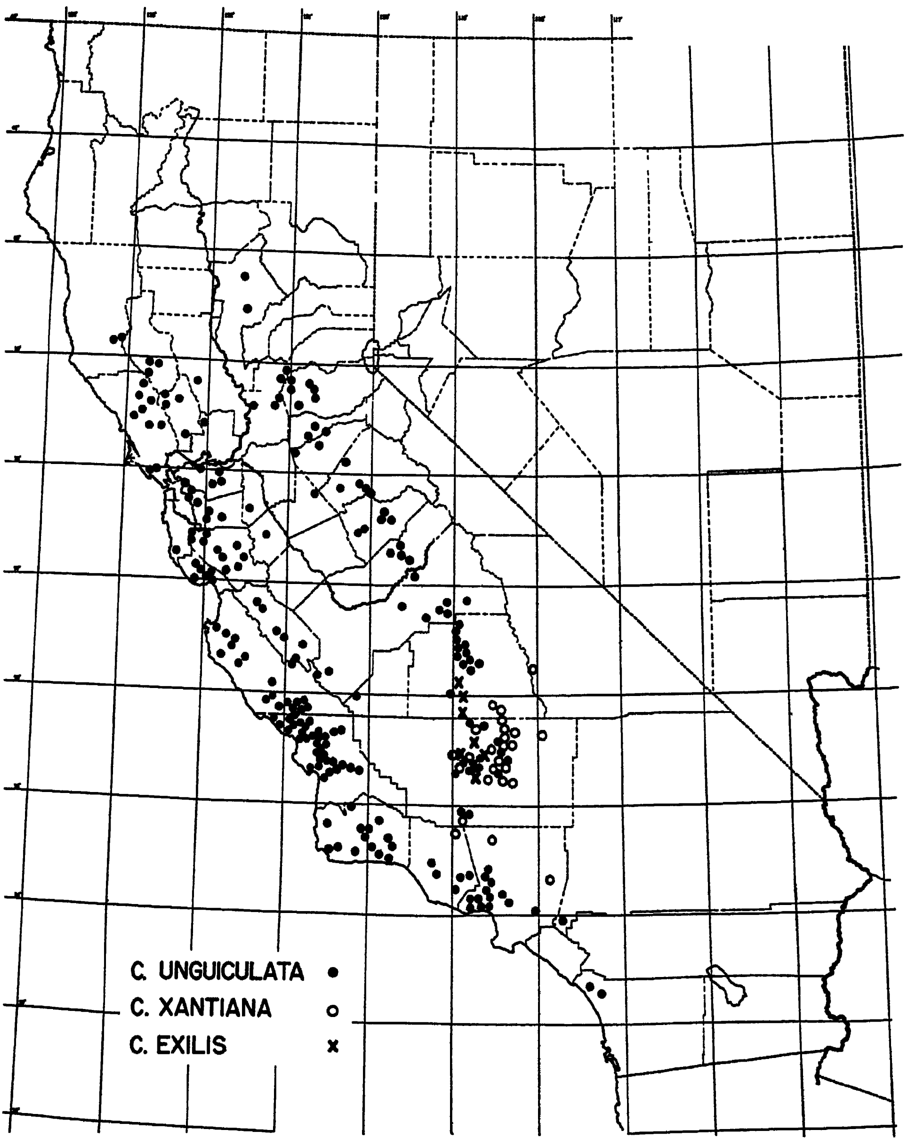


Fig. 23. Distribution of *Clarkia unguiculata, C. xantiana,* and *C. exilis.*

Tulare, Tuolumne, Ventura, and Yolo counties. Frequent in the woodland of the Coast Ranges and Sierra Nevada foothills.

Representative specimens.—CALIFORNIA. Alameda County: near Sunol, Niles Canyon, *Mason 3250.* Amador County: New York Falls, *Hansen 531.* Butte County: Table Mountain, 8 miles north of Oroville, *Heller 10767.* Calaveras County: Wallace, *McMurphy* in 1914. Contra Costa County: Marsh Creek Canyon, *Stanford 1510.* Eldorado County: Folsom–Green Valley Road, 1.3 miles east of road to Salmon Falls, *Wolf 4966.* Fresno County: Tehipite Valley, *Hall & Chandler 465.* Kings County: Kettleman Hills near Avenal, *Hoover 3301.* Kern County: Fort Tejon, *de Vesey 30.* Lake County: just above south shore of Soda Lake, *Simontacchi 266.* Los Angeles County:

Mandeville Canyon, *Clokey & Templeton 4540*. Madera County: Fresno Flats on Fresno River, 1 mile southwest of Oakhurst, *Constance 2377*. Marin County: hills above Fairfax, *Brandegee* in 1905. Mariposa County: El Portal, Yosemite, *Coombs* in 1916. Mendocino County: Ukiah, *Eastwood 3404*. Monterey County: Santa Lucia Mountains, *Plaskett* in 1898. Napa County: Pope Valley Creek near Samuels Springs, *Howell 4268*. Placer County: Loomis, *Rixford* in 1914. Sacramento County: near Folsom, *Copeland 1611*. San Benito County: Griswold Hills, 4 miles southeast of Paicines, *Constance & Morrison 2267*. San Diego County: U.S. Highway 395, just south of the San Luis Rey River, *Lewis et al. 770;* 4 miles from Bonsall, on road to Moosa Canyon, *Stark 5673*. San Luis Obispo County: Atascadero Ranch, Santa Margarita Valley, *Brewer 490*. San Joaquin County: Corral Hollow, *Eastwood & Howell 5291*. San Mateo County: Alpine School House, *Elmer 4293*. Santa Barbara County: Santa Barbara, *Elmer 3877*. Santa Clara County: Los Gatos Canyon, *Heller 7482*. Santa Cruz County: Boulder Creek, *Walker 748*. Sonoma County: Santa Rosa Creek, east of Santa Rosa, *Heller 5686*. Stanislaus County: Knights Ferry, *Howell 2016*. Tulare County: Three Rivers, *Eastwood 4208*. Tuolumne County: Five Mile Creek near Columbia, *Lundgren* in 1933. Ventura County: Cuyama Canyon, *Jones* in 1926.

We have studied progenies from the following localities in the experimental garden. Eldorado County: 0.6 mile north of Nashville School on Highway 49, *373;* 2.6 miles north of Placerville city limits on Highway 49, *375;* 3.5 miles east of bridge over South Fork of American River on Pilot Hill–Salmon Falls Road, *384*. Fresno County: Highway 198, 0.5 mile east of Monterey County line, *1;* 9 miles southwest of Auberry, *25;* 1.6 miles south of Dunlap, *319*. Los Angeles County: Santa Monica Mountains, 1.7 miles west of fire station on Mulholland Drive, *33;* Santa Monica Mountains, 0.1 mile east of Canoga Avenue on Mulholland Drive, *35;* Los Angeles, Temple Street near Silver Lake Boulevard, *766*. Madera County: 2.4 miles south of road to O'Neals on Highway 41, *240*. Mariposa County: Highway 49, 1 mile west of road to Hornitos and Snelling, *343*. Monterey County: Bradley-Jolon Road, 10.7 miles west of U.S. Highway 101, *49;* Bradley-Jolon Road, 1.1 miles west of road to Pleyto, *50;* 0.4 mile south of Bradley-Jolon Road on road to Pleyto, *491;* road to Tassajara, 2.9 miles northwest of road to Cachuga, *721*. Plumas County: Highway 24, 0.5 mile south of Bridge 9–04 over Feather River, *754*. San Luis Obispo County: 3.5 miles east of Santa Margarita on road to Creston, *41;* Salinas River Bridge on Santa Margarita–Creston Road, *43;* 2.8 miles east of Los Padres National Forest boundary near Pozo, *171;* Huerhuero Bridge, 4.1 miles east of Paso Robles on Highway 41, *252;* 1.8 miles east of entrance to Cerro Alto Camp on Morro Bay–Atascadero Road, *473*. Santa Barbara County: 5.4 miles north of summit of San Marcos Pass, *450;* 1.4 miles north of Davy Brown Camp, *454;* Gaviota Pass, *458*. Sonoma County: Highway 29, 2.2 miles north of Calistoga, *108;* 1.3 miles west of Mark West Spring, *867*. Tulare County: 0.4 mile west of Lookout Point Ranger Station on road to Mineral King, *148;* road to Mineral King, 3.1 miles east of road to Sequoia, *149;* 3.1 miles east of Cold Spring entrance to Sequoia National Park, *151;* 0.2 mile east of Tulare County Fire Station on Exeter-Springville Road, *298;* 1.3 miles north of Homer Ranch on Kaweah River–Badger Road, *302;* Kaweah River–Badger Road, 2.6 miles south of road to M Bar J Ranch, *306*. Tuolumne County: Highway 120, 2 miles west of road to Knights Ferry *112;* 5.8 miles north of Jacksonville on road to Stent, *354*.

Clarkia unguiculata is a morphologically variable species with respect to many characters both within and between colonies. Leaf shape and size shows sufficient variation on a single individual to obscure most differences that may occur within or between populations. Some colonies from San Benito, Alameda, and western Fresno counties, however, consistently have leaves somewhat narrower than usual (e.g., Corral Hollow, *Eastwood & Howell 5291*). Variation in the flowers is more conspicuous. The buds may be elongated and tapering or broad and rounded or even globose depending upon the length of the sepal in relation to its width. The shape of the bud is usually more or less consistent within a given population. Populations with globose buds are found predominantly in the Sierra Nevada foothills but not to the exclusion of other bud shapes. The color of sepals of many of the populations with globose buds is a very dark red, giving the sepals a petaloid aspect. The type specimen of *C. eiseniana* Kellogg is of this sort. Particular bud shapes and sepal colors, however, are by no means always associated (e.g., globose buds with dark-red sepals: Madera County: Fresno Flats on Fresno River, 1 mile southwest of Oakhurst, *Constance 2377*, and San Joaquin Experiment Range, *Biswell 59;* Mariposa County: El Portal, *Coombs* in 1916; Fresno County: 1 mile northwest of Auberry, *Bullard 4*, and Big Sandy Creek, *McDonald* in 1915. Globose buds with greenish sepals: Fresno County: Tehipite Valley, *Hall & Chandler 465*. Elongate buds with dark-red sepals: Tulare County: Dry Creek on the road to General Grant Park, *Jessel* in 1927, and Hot Springs, *Kelley* in 1922; Kern County: 4 miles east of Poso Flat, *Benson 8313;* Ventura County: Sulphur Mountain Spring, *Abrams & McGregor 16*). The petals exhibit conspicuous differences in color, varying from bright reddish-purple to various shades of pink, lavender, salmon, or white. The petals may be uniform in color, or more frequently they have a darker zone of color near the base of the claw or at the base of the limb, or both. Sometimes these darker-colored areas are confluent. The shape and size of the petals may also vary conspicuously, particularly from colony to colony. Some colonies (e.g., in the upper Carmel Valley, Monterey County), have petals with exceptionally large and broad limbs, whereas others from the same area are much smaller. The limb of the petal may be hemispherical, deltoid, rhomboid, or wedge-shaped. The claw is usually entire, but an occasional population (e.g., *25*) may have a few lateral teeth near the base. The stamens may vary in color and the ovary often varies in size. The pubescence of the ovary, hypanthium, and sepals is especially variable. This pubescence may consist entirely of long, straight, spreading hairs, as much as 3 mm. long. On the other hand, the pubescence may consist of short hairs, which are either straight and gland-tipped or curled and eglandular. Each of the pubescence types may be sparse, dense, or absent. They apparently vary independently. A given individual may, therefore, have one or all three types of hairs, and in any proportion, or it may be glabrate. The color of the longer hairs varies from white to dark reddish-purple.

Under uniform garden conditions at Los Angeles, differences in rate of growth, time of flowering, and ultimate size are also evident. The largest plants were those indigenous at Los Angeles (*766*), whereas the smallest were derived from Sonoma County (*867*), near the northern limit of distribution of the species. In general, those plants derived from seeds from higher elevations grew more slowly and flowered later than did those from lower elevations in the same area. We have found no conspicuous morphological characters associated with these ecotypic differences except for the over-all size of the plant. *Clarkia unguiculata* is almost inevitably found growing in oak or oak-digger pine woodland. One notable exception was a small population which we found in the San Joaquin Valley near Mendota (*911*), in an area completely devoid of trees of any description. It is possible that these plants may have come from seeds washed from adjoining mountains. Nevertheless, another record has come from the Kettleman Hills (*Hoover 3301*), a treeless area a few miles farther south, into which seeds could hardly have washed.

The haploid chromosome number is 9. Over five hundred plants from at least 125 populations in fourteen counties have been examined cytologically. Most of these observations have been previously discussed (Lewis, 1951, as *C. elegans*). The normal somatic chromosome number is 18, but many plants in some areas have from 1 to 6 chromosomes in addition to the normal complement. Furthermore, these same populations contain numerous individuals that are heterozygous for structural rearrangements. At least 6 chromosomal arrangements are necessary to account for the observed meiotic configurations. As yet we have found no correlation between morphological variation and particular chromosomal arrangements or supernumerary chromosomes. We have found no basis for Johansen's (1930) report of a diploid number of 14 chromosomes at zygotic mitosis nor for his report (1929*a*) that the haploid number varies from 3 to 11 and diploid from 7 to 22 chromosomes.

Genetic studies of flower color of *C. unguiculata* (*C. elegans;* see Appendix II) have been reported by Rasmuson (1920) in which he found at least two genes involved. White color was homozygous for the two recessive alleles. An extensive genetic program using this same species was conducted for a number of years by Burlingame, but he did not publish his results.

Fasciation is a frequent anomaly in *C. unguiculata*, and is readily detected even in early embryos (Johansen, 1930).

Relationship.—*Clarkia unguiculata* is morphologically most closely related to *C. exilis*, a species known only from a small area in Kern and Tulare counties, California. The two species grow together in this area. *Clarkia unguiculata* is readily distinguished in this area by its larger size, coarser habit, larger petals, and pilose pubescence on the ovary and calyx. Furthermore, *C. unguiculata* blooms about a month later than *C. exilis*, although their flowering periods overlap. *Clarkia unguiculata* is also closely related to *C. xantiana*. They are very similar vegetatively, although the latter has as a rule much narrower leaves. However, plants of *C. unguiculata* that we have found in dry sites (e.g., *911*, near Mendota) strongly suggested *C. xantiana* in gross aspect. *Clarkia xantiana* is adapted to drier sites than *C. unguiculata* and extends farther toward the margin of the desert, although they are sympatric in some areas. When the two are found growing together, *C. unguiculata* occupies the more moist part of the site. The two species can be readily distinguished on the basis of the unique petal shape of *C. xantiana*. Munz and Hitchcock (1929) related *C. unguiculata* to *C. rhomboidea*, but this relationship can be shown to be relatively remote on both morphological and cytological grounds. On the other hand, the relationship of *C. unguiculata* to *C. deflexa* in Section Fibula may be close (see *C. deflexa*). *Clarkia unguiculata* is one of the parents of *C. delicata* (Section Connubium).

26. **Clarkia exilis** Lewis & Vasek, Madroño 12: 211. 1954. (Fig. 22, *c*, *d*.)

Erect, 2–6 (10) dm. tall; stems slender, simple, or branched, glabrous and glaucous; leaf blades 1–6 cm. long, 2–14 mm. broad, the upper lanceolate, the lower narrowly elliptic, glabrate, sessile, or with petioles as much as 5 mm. long; rachis of the inflorescence erect; buds deflexed, becoming erect as the flowers open; hypanthium obconical to campanulate, 1–3 mm. long, not conspicuously colored within, the ring of hairs at or above the middle; sepals oblanceolate, 5–13 mm. long, 1–2 mm. broad, green, remaining united and deflexed to one side at anthesis, minutely and sometimes sparsely puberulent; petals 5–15 mm. long, 2–7 mm. broad, conspicuously clawed, the claw slender, equaling the limb, the limb rhomboid, lavender-pink or white, often with a darker reddish-purple spot at the base; stamens 8, similar; anthers white or the outer sometimes larger and reddish; pollen white or cream, sometimes purplish-gray; stigma 4-lobed, the lobes short, rounded; style at maturity equaling the stamens; ovary 8-ribbed, 6–16 (20) mm. long, bright green, puberulent, sessile or on a pedicel as much as 3 mm. long; mature capsule curved, 15–30 mm. long, 2–3 mm. broad, scarcely if at all beaked; seeds brown, about 1 mm. long, tuberculate, the crest minute.

Type.—Kern River Canyon, 1 mile from the mouth, Kern County, California, *Lewis, Lewis, & Vasek 908*, April 19, 1952 (U.C.L.A.).

Distribution (see fig. 23).—CALIFORNIA. Kern and Tulare counties. Usually in shady or north-facing sites in the woodland.

Specimens examined.—CALIFORNIA. Kern County: Kern River Canyon, *Abrams* in 1900; mouth of Kern Canyon, *Benson 3344, 3463, 3464;* lower Kern River Canyon, 1 mile from the mouth, *Lewis, Lewis, & Vasek 908* (type); *Vasek 101, 121;* 2.3 miles from the mouth, *Vasek 122;* 2.9 miles from the mouth, *Vasek 123;* 3.8 miles from the mouth, *Vasek 124;* 4 miles from the mouth, *Abrams 11990, 12009;* 12 miles above mouth, *Keck & Stockwell 3264;* Rancheria Road, 9 miles from junction with Kern River Highway, *Vasek 125;* Breckenridge Mountain Road, 2 miles west of the junction with the road to Kern River Highway, *Vasek 127;* 1.1 miles north of Granite Station on the road to Woody, *Vasek 130.* Tulare County: 3 miles east of White River, *Vasek 131;* Deer Creek Road, 11.4 miles west of California Hot Springs, *Vasek 132;* Tule Indian Reservation Road, 0.2 mile east of junction with Bartlett Park Road, *Vasek 133.*

Progenies from the type locality have been studied in the experimental garden. The haploid chromosome number is 9, based on examination of microsporocytes of three plants from the type locality and two plants from Rancheria Road, *Vasek 125*. In addition, Vasek (1955) has examined meiosis in twelve plants grown in the garden. No meiotic irregularities have been observed.

The most conspicuous morphological variation is found in the color of the petals. They are most frequently a bright lavender-pink and may or may not have a darker reddish-purple spot at the base of the limb. In addition, many of the plants have white flowers. These variants occur throughout most of the area of distribution, but not in all populations.

Relationship.—*Clarkia exilis* is very closely related to *C. unguiculata.* Herbarium specimens of *C. exilis* were considered by us to represent variants of *C. unguiculata* until the two taxa were observed growing side by side in the Kern River Canyon. At this site, the slender plants of *C. exilis* with smooth buds and narrow petals were in flower, whereas the coarser plants of *C. unguiculata* with pilose buds were not yet in flower. No intermediates could be found. Vasek (1955) has subsequently examined the nature and degree of the morphological hiatus between the two taxa and has made many interspecific pollinations. Seeds are obtained from these pollinations, but they usually either fail to germinate or growth becomes arrested in the cotyledon stage. However, one mature hybrid has been obtained which proved to be essentially sterile. Within its area of distribution, *C. exilis* is easily distinguished from *C. unguiculata* by the traits indicated above. *Clarkia unguiculata* is a notably variable species, however, and taken as a whole no single character distinguishes all of its variants from *C. exilis*, except, perhaps, for the relative length of the style and stamens on the one hand and the relative length of the ovary and calyx at anthesis on the other. The length of the ovary in *C. exilis* is about equal to the length of the sepals and hypanthium combined; the ovary of *C. unguiculata* is conspicuously shorter than the combined length of the sepals and hypanthium.

27. **Clarkia xantiana** Gray, Proc. Bost. Soc. Nat. Hist. 7: 146. 1859.

(Fig. 22, *e, f.*)

Erect, as much as 8 dm. tall; stems simple or branched above, glabrous and glaucous; leaves linear to narrowly lanceolate, entire or inconspicuously denticulate, 2–6 cm. long, 1.5–6 (9) mm. broad, sparsely puberulent, usually sessile or with petioles as much as 2 mm. long; rachis of the inflorescence erect; buds deflexed, becoming erect as the flowers open; hypanthium campanulate to obconical, 2–5 mm. long, not conspicuously colored within, the ring of white hairs forming a broad band 1–2 mm. wide at the upper margin; sepals grayish-green or reddish, oblanceolate, 6–20 mm. long, 1–3 mm. broad, remaining united and deflexed to one side at anthesis; petals 6–20 mm.

long, conspicuously clawed, the limb 2-lobed, with a subulate tooth 1–3 mm. long in the sinus, the lobes ⅓ to ½ the length of the petal, lavender to reddish-purple, usually lighter near the base, rarely white, the upper petals usually with a dark reddish-purple spot surrounded with white, the spot variable and often absent; stamens 8; anthers lavender to purple; pollen of the outer anthers blue, the inner cream to bluish-gray; filaments purple to lavender or white; stigma 4-lobed, the lobes rounded, white to pale lavender; style lavender, exceeding the stamens; ovary 10–17 mm. long, puberulent, conspicuously 8-ribbed, sessile or on a pedicel as much as 2 mm. long; immature capsule pale and often shiny, 1.5–3 cm long, 3–4 mm. broad; mature capsule 1.5–2.5 mm. broad, straight or curved, 4-sided but scarcely quadrangular, usually with a slender beak as much as 2 mm. long; seeds brown, 1.3–1.5 mm. long, tuberculate, the crest minute.

Type.—Fort Tejon and vicinity, Kern County, California. *Xantus de Vesey 31*, 1857–1858, (Gray Herbarium).

Phaeostoma xanthiana Nels., Bot. Gaz. 52: 267. 1911.

Clarkia parviflora Eastw., Bull. Torrey Bot. Club 30: 492. 1903. Type: Kernville, Kern County, California, *T. S. Brandegee* (Cal. Acad.). *Phaeostoma parviflora* Nels., Bot. Gaz. 52: 267. 1911.

Distribution (see fig. 23).—CALIFORNIA. Inyo, Kern, Los Angeles, Tulare, and Ventura counties. Dry slopes, usually in oak-digger pine woodland.

Representative specimens.—CALIFORNIA. Inyo County: Olancha Pass Trail, east slope of Sierra Nevada, *Alexander & Kellogg 2942*. Kern County: mouth of Kern Canyon, *Benson 3625;* Erskine Creek, *Purpus 5538;* Old Fort Tejon, *Hall 6306*. Los Angeles County: Big Rock Creek, San Gabriel Mountains, *Munz 6879*. Tulare County: 2 miles southeast of Johnsondale Sawmill, Canyon of South Creek, Lower Kern River Canyon, *Bacigalupi & Ferris 2459*.

Progenies from the following localities have been studied in the experimental garden. Kern County: Caliente Creek, 2.8 miles east of Caliente, *832;* Walker Pass, 3.8 miles west of summit, *840*. Los Angeles County: 0.2 mile north of Three Point, *38*. Tulare County: Kern River Bridge at South Creek, *841;* Kern River about 0.5 mile north of the bridge at South Creek, *843*.

The haploid chromosome number is 9, based upon examination of microsporocytes and root tips of two individuals from population *38*. In addition, microsporocytes of two individuals from population *841* have been examined by Vasek. No meiotic irregularities have been observed.

Clarkia xantiana varies most conspicuously in the color, markings, and size of the flower. The normal flower color is a bright pinkish-lavender and the principal variation is in the intensity of color. Sporadic white-flowered individuals do occur, and we have found one population in the Kern River Canyon (*841*) which is entirely white. The spotting on the petal is highly variable from one petal to the next, and the expression of the spot seemingly depends at least in part upon the orientation of the petal. Many individuals and some populations have no marks on the petals. One of the extreme variants in flower size has been described (*C. parviflora* Eastw.). We are familiar with similar variants both in the field and in the experimental garden, as well as the herbarium. The small flowers are not necessarily associated with depauperate plants and thus may be assumed to be genetically determined. In 1951, however, a field study was made in which twenty-one populations in Kern and Tulare counties were carefully examined. Small-flowered individuals occurred as a sporadic and minor element.

Relationship.—*Clarkia xantiana* is unique among species of *Clarkia* in having a 2-lobed petal with a small subulate tooth in the sinus. This tooth is always evident, although it may be partly fused to one of the larger lobes of the petal. Munz and Hitchcock (1929) considered *C. xantiana* to be closely related to *C. pulchella*, largely perhaps on the basis of the conformation of the petal. It can be shown, however, on both morphological and cytological grounds that this relationship is remote (see

C. pulchella). On the other hand, the morphological resemblance of *C. xantiana* to *C. unguiculata* is very close if one is willing to overlook the conspicuous difference in the shape of the petals. This difference is probably a simple one inasmuch as Hiorth (1941) has found a mutant in *C. amoena* which produces a petal very similar to the unique shape of *C. xantiana*. *Clarkia xantiana* and *C. unguiculata* have the same chromosome number and morphologically similar karyotypes, although the few attempts that have been made to cross them have been unsuccessful.

SECTION MYXOCARPA SEC. NOV.

Herbae erectae; caulibus pubescentibus vel subglabris; inflorescentium axe in apice recurvato; calycis tubo cyathiformo, 1–4 mm. longo; calycis limbo sub anthesi viritim recurvato interdum connato et declinato; petalis ad unguiculos lobatos angustatis; staminibus 8, in basi squamis ciliatis, circulis duo similibus; antheris obtusis vel acutis vel mucronatis, plus minusve filamenta aequante; ovario subtereti vel 4-canaliculato interdum 8-lineato, in maturitate molli et limoso; capsula quadrangulata et sicca.

Erect herbs; stems puberulent to glabrate; rachis of the inflorescence recurved in bud, the buds pendulous or deflexed; hypanthium campanulate, 1–4 mm. long; sepals usually reflexed individually at anthesis, sometimes remaining united and deflexed to one side; petals constricted into a rather broad claw with a pair of prominent lateral projections near the base; stamens 8, in 2 similar series, subtended by conspicuous ciliated scales; anthers obtuse, acute, or mucronate, more or less equaling the filaments; immature capsule subterete or 4-grooved, sometimes 8-striate, becoming soft and slimy; mature capsule dry and quadrangular.

Type species.—*C. rhomboidea* Dougl.

Relationship.—Section Myxocarpa is most closely related to the alloploid Section Clarkia, because a species of Myxocarpa has almost certainly contributed a genome to the formation of the latter (see *C. pulchella*). The relationship of Section Myxocarpa to other sections is rather obscure. However, anthers with acute or mucronate tips are known only in sections Myxocarpa and Primigenia. Furthermore, one of the species of Section Myxocarpa, *C. mildrediae*, has a haploid chromosome number of 7, which is ancestral for the genus. This suggests that Myxocarpa has probably been derived from a Primigenia-like stock.

28. **Clarkia mildrediae** (Heller) Lewis & Lewis, Madroño 12:33. 1953.
(Fig. 24, *e, f.*)

Erect, as much as 8 dm. tall; stems usually branched, puberulent above with short, upwardly curled hairs, sometimes sparsely so, sparsely puberulent or glabrate below; leaf blades ovate or elliptic, entire, 3–6 cm. long, 1–3 cm. broad, narrowed to petioles 15–40 mm. long; rachis of the inflorescence recurved in bud, becoming erect as the flowers open; hypanthium 2–3 mm. long, not conspicuously colored within; sepals lanceolate, 13–19 mm. long, 2–3 mm. broad, remaining united and deflexed to one side at anthesis or reflexed individually; petals 14–21 mm. long, 10–14 mm. broad, bright reddish-purple or magenta to pale lavender, flecked with purple near the base of the limb, the limb deltoid or rounded, narrowed into a claw having a pair of lateral lobes above the slender base, the base of the claw and the lateral lobes usually dark reddish-purple; stamens 8, subtended by prominent scales fringed with white hairs, the scales opposite the longer stamens as much as 3 mm. long, the shorter scales directed inward; filaments and anthers the color of the petals or somewhat darker and brighter; pollen blue; stigma lavender to purple, 4-lobed, the lobes about as long as broad; mature style the color of the petals, exceeding the stamens in length; ovary 5–15 mm. long, puberulent, subterete, nearly sessile or on a pedicel as much as 5 mm. long; immature capsule inconspicuously 4-grooved, often streaked with red, becoming soft and slimy, usually beaked, the beak as much as 4 mm. long; mature capsule 2–3 cm. long, 2–3 mm. broad, quadrangular, often tipped or streaked with red, straight or curved; seeds brown or gray, 1.5–1.8 mm. long, scaly-echinate, the crest about 0.1 mm. long.

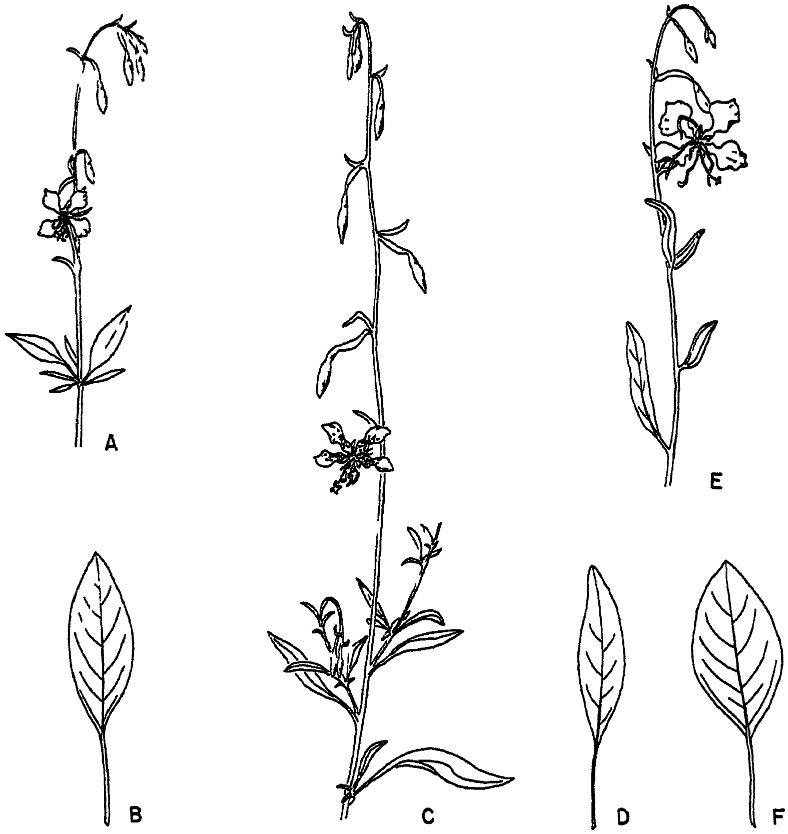


Fig. 24. *a*, *Clarkia rhomboidea*, inflorescence × ½; *b*, leaf × ½; *c*, *C. virgata*, inflorescence × ½; *d*, leaf × ½; *e*, *C. mildrediae*, inflorescence × ½; *f*, leaf × ½.

Type.—Based on the type of *Phaeostoma mildredae* Heller. State Highway 24, west of Arch Rock Tunnel, Butte County, California, *Heller 15153* (isotype examined, U.S. National Herbarium).

Phaeostoma mildredae Heller, Leafl. W. Bot. 2: 221. 1940.

Distribution (see fig. 25).—CALIFORNIA. Butte, Plumas, and Shasta counties. Known only from two rather restricted areas; one is along the North Fork of the Feather River, the other is the Shasta Lake area. In the latter area it was apparently common in the canyons now inundated by Shasta Lake but can still be found in the canyons adjacent to the lake.

Specimens examined.—CALIFORNIA. Without County: St. Lawrence, *Jones* in 1882. Butte County: 0.05 mile west of Arch Rock Tunnel, Highway 24, *Heller 15153; Lewis, Lewis, & Vasek 756;* 2 miles west of Arch Rock Tunnel, Highway 24, *Lewis, Lewis, & Vasek 760.* Plumas County: Lakes Center Camp, *Head* in 1920; Camp Bodgers, *Head* in 1920; 1 mile southeast of Mt. Arat, *Nordstrom 167;* 11 miles southwest of Belden, *Rose 39257;* Highway 24 near Bucks Creek Power House, *Heller 15708;* Highway 24, 5.2 miles southwest of Yellow Creek Bridge 9–08, *Lewis, Lewis, & Vasek 749;* Highway 24, 5.6 miles southwest of Yellow Creek Bridge, *Lewis, Lewis, & Vasek 750;* Highway 24, 7.8 miles southwest of Yellow Creek Bridge, *Lewis, Lewis, & Vasek 752;* Highway 24, 0.5 mile southwest of Bridge 9–04, *Lewis, Lewis, & Vasek 753.* Shasta County: Pacific Highway between Salt Creek and Pollack, *Heller 14611;* Pitt to Baird, *Eastwood 1327, 1430;* Pitt River *L. E. Smith* in 1913; Gray Rocks, *Johannsen 140;* between Morley's and Stevens, *M. S. Baker 386;* O'Briens, *Lewis & Lewis 882, 883.*

Progenies from the following localities have been studied in the experimental garden. Butte County: 2 miles southwest of Arch Rock on Highway 24, *760.* Plumas County: Highway 24, 5.2

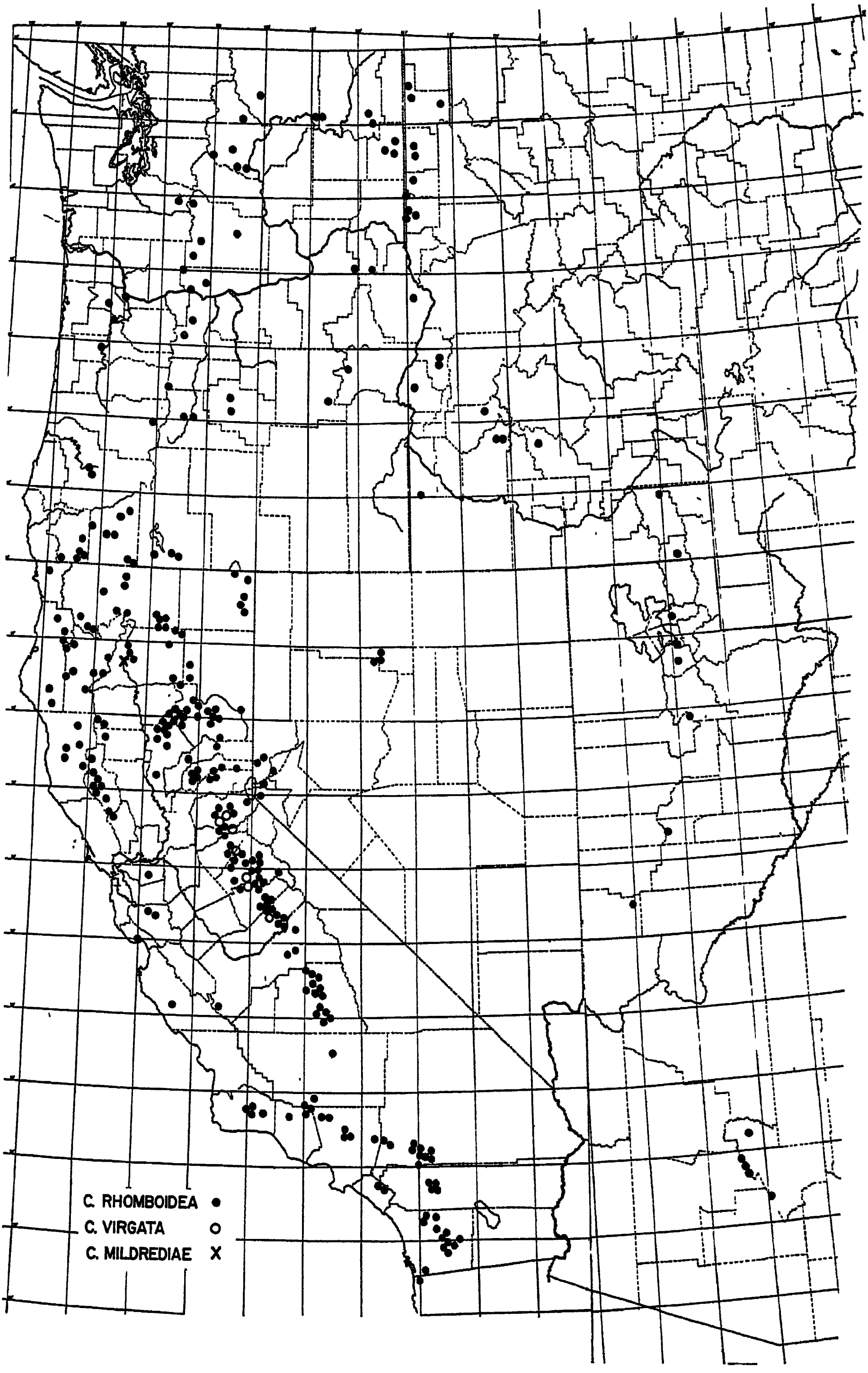


Fig. 25. Distribution of *Clarkia rhomboidea*, *C. mildrediae*, and *C. virgata*.

miles southwest of Yellow Creek Bridge, 9–08, *749;* Highway 24, 5.6 miles southwest of Yellow Creek Bridge, *750;* Highway 24, 0.5 mile southwest of Bridge 9–04 over Feather River, *753.* Highway 24, 0.8 mile northeast of Arch Rock, *755.* Shasta County: O'Briens at Shasta Lake, *882, 883.*

The haploid chromosome number is 7, determined from microsporocytes of one or more plants from each of the following collections: *750, 755, 882,* and *883.* No meiotic irregularities have been observed in these plants, although hybrids between Shasta Lake and Feather River populations indicate interchanges between at least 3 chromosomes.

Clarkia mildrediae is quite uniform except for flower color. The plants from the Feather River have rich magenta flowers, whereas those from Shasta Lake are lavender and very much paler.

Relationship.—Clarkia mildrediae is morphologically very similar to *C. rhomboidea.* When we first examined herbarium material of the former we considered it to be an extreme variant of the latter, which is a notably variable species. When it became evident that *C. rhomboidea* was an allotetraploid species, however, with *C. virgata* as one of its parents, plants of the description of *C. mildrediae* were sought as the missing diploid parent (see *C. rhomboidea*). On this hypothesis, *C. mildrediae* should have a haploid chromosome number of 7. When material of this species was eventually obtained the predicted chromosome number was verified. Subsequently, the hybrids necessary to demonstrate the relationship between *C. mildrediae* and *C. rhomboidea* were made. *Clarkia mildrediae* can usually be easily distinguished from *C. rhomboidea* on the basis of the much larger flowers and broader leaves of the former. *Clarkia mildrediae* is also closely related to *C. virgata* but differs morphologically in having much broader petals and leaves than the latter. The basic chromosome number of *C. mildrediae* is apparently ancestral in the genus, whereas *C. virgata* has a derived genome of 5. *Clarkia mildrediae* may well have been the species from which *C. virgata* has been derived. If not, the ancestral species was probably very similar to *C. mildrediae.*

29. **Clarkia virgata** Greene, Erythea 3: 123. 1895. (Fig. 24, *c, d.*)

Erect, as much as 1 m. tall; stems usually branched, puberulent with short, upwardly curled hairs, sometimes sparsely so, glabrate or sparsely puberulent below; leaf blades lanceolate to narrowly elliptic, entire, 2–4.5 cm. long, 3–12 mm. broad, narrowed into petioles 5–15 mm. long; rachis of the inflorescence recurved, becoming erect before the flowers open; buds deflexed, becoming erect as the flowers open; hypanthium 3–4 mm. long, not conspicuously colored within; sepals lanceolate, 10–15 mm. long, 2–3 mm. broad, gray-green or reddish; petals 7–14 mm. long, 3–7 (10) mm. broad, purple to dark lavender, mottled or spotted with reddish-purple, especially on the claw, the limb rhomboid, the claw with a pair of rounded or denticulate lateral projections near the base, the base dark red or reddish-purple; stamens 8, subtended by conspicuous white ciliated scales 1–2 mm. long; filaments usually dark reddish-purple; anthers purple; pollen blue; stigma the color of the petals, 4-lobed, the lobes about as long as broad; mature style equaling or exceeding the longer stamens; ovary 8–12 mm. long, puberulent, subterete, nearly sessile or on a pedicel as much as 4 mm. long; immature capsule shallowly 4-grooved or 8-striate, becoming soft and slimy, usually beaked, the beak about 1 mm. long; mature capsule quadrangular, straight or curved, 10–20 mm. long, 2–2.5 mm. broad, often tipped or streaked with red; seeds brown, 1–1.5 mm. long, scaly-echinate, the crest obscure or as much as 0.1 mm. long.

Type.—At the time of describing *C. virgata,* Greene stated: "known to me only from Sonoma and Amador counties, California. The collectors Mr. Bioletti and Mr. Hansen." We have examined these collections in the Greene Herbarium at Notre Dame. The Bioletti collection from Sonoma County is referable to *C. rhomboidea,* whereas the three sheets collected by Hansen in Amador

County (19600, 19601, 19598) represent a species distinct from *C. rhomboidea*. One of these sheets, 19598, is taken as the lectotype of *C. virgata* Greene.

Clarkia rhomboidea f. *virgata* Munz & Hitch., Bull. Torrey Bot. Club 56: 191. 1929.

Distribution (see fig. 25).—CALIFORNIA. Amador, Calaveras, Eldorado, Madera, Mariposa, and Tuolumne counties. Lower margin of the montane forest and adjacent oak-digger pine woodland.

Specimens examined.—CALIFORNIA. Without county: South Fork of the American River, *Hawthorne & Blaisdell* in 1899; "Santa Cruz," *Jones 2255*. Amador County: Irishtown, *Hansen 528;* Hams, *Hansen 1092;* Armstrong's Station, *Hansen 1092;* Agriculture Station, *Hansen 528*. Calaveras County: Calaveras Ranger Station, Avery, *Eggleston 9701;* Snowden Ranch, *Jepson* in 1890. Eldorado County: Ridge west of Plum Creek, *Gifford 275;* Camino, *Brandegee* in 1908; Riverton (Moore's Bridge), *Brandegee* in 1908. Madera County: 2 miles south of Pilot Peak, *Schlobohm 160*. Mariposa County: 0.5 mile from Dogtown on road from Dogtown to Ponderosa Way, *Miller* in 1939; Toll House, about 3 miles east of Bower Cave, Coulterville Trail to Yosemite, *Jepson 14422*. Tuolumne County: Sullivan Creek, 0.5 mile west of Twain Harte Post Office, *Alexander & Kellogg 3670;* Tioga Road near South Fork of Tuolumne River, *Eastwood 161*.

Progenies from the following localities have been studied in the experimental garden. Eldorado County: Institute of Forest Genetics, Placerville, *900*. Tuolumne County: Hog Ranch, Mather, *102;* 0.5 mile east of Hardin Flat on Big Oak Flat Road to Yosemite, *762*.

The haploid chromosome number is 5, based upon examination of microsporocytes from one or more individuals from progenies of *102*, *762*, and *900*. In addition, buds collected in the wild at Berkeley Tuolumne Camp, Big Oak Flat Road to Yosemite (*763*), were also examined. One plant from population *900* had 13 chromosomes which formed 6 pairs plus an unpaired chromosome during meiosis. It was not notably different morphologically, however, from eight other plants from the same progeny, each of which had normal genomes of 5 chromosomes.

Clarkia virgata is a relatively uniform species but varies somewhat in flower color and petal shape. The petals are usually rather narrow and elongate, but at times they may be broader and then suggestive of *C. rhomboidea*. The flecking on the petals is variable but usually so abundant as to be confluent, thus producing a mottled effect. The anthers are characteristically dark purple, but occasional variants in the progeny of *762* had lavender anthers.

Relationship.—Clarkia virgata is morphologically very similar to *C. rhomboidea*. We were, in fact, not cognizant of the specific status of the former until a genetic discontinuity was indicated by the difference in chromosome number. *Clarkia virgata* has since proved to be one of the parents of the allotetraploid species, *C. rhomboidea*. The two species grow together in Tuolumne County, and when observed side by side in the field or in the garden several differences become apparent. *Clarkia virgata* is a more slender plant with somewhat narrower leaves; the petals are generally narrower and more purple and mottled, rather than reddish and flecked as in *C. rhomboidea*. The anthers of *C. virgata* are usually purple rather than pinkish-lavender. The rachis of the inflorescence is reflexed in both species, but in *C. virgata* it becomes erect well in advance of the opening of the flowers with the result that the stem is erect several internodes above the uppermost open flowers, whereas in *C. rhomboidea* the stem is bent almost to the uppermost open flower. *Clarkia rhomboidea* begins to bloom several weeks before *C. virgata* in the area where the two occur together, but the flowering periods overlap. In the garden, *C. rhomboidea* begins flowering about six weeks before *C. virgata*. The flowers of *C. virgata* are protandrous and have relatively long styles which promote outcrossing, whereas in most races of *C.*

rhomboidea the stigma and anthers mature at the same time and the pollen of a flower is usually deposited on its own stigma.

Clarkia virgata is closely related to *C. mildrediae*, the other parent of *C. rhomboidea*. They are readily distinguished from each other, however, by the shape of the petal and leaves. The petals and leaves of *C. virgata* are much narrower. The morphological similarity of these two species and the low, apparently derived, chromosome number of *C. virgata* suggest that it has been derived from *C. mildrediae* or a species very similar to it. These two species are apparently not sympatric today, but they must have grown in the same area at the time of the origin of *C. rhomboidea.*

30. **Clarkia rhomboidea** Douglas, Hook. Fl. Bor. Am. 1: 214. 1834.
(Fig. 24, *a*, *b*.)

Erect, as much as a meter tall; stems simple or branched, puberulent above with short, upwardly curled hairs, sometimes sparsely so, glabrate to sparsely puberulent below; leaf blades lanceolate to elliptic or ovate, entire or nearly so, 1–6 cm. long, 4–23 mm. broad, puberulent, narrowed into petioles as much as 25 mm. long; rachis of the inflorescence recurved, becoming erect as the flowers open; buds pendulous; hypanthium 1–3 mm long, not conspicuously colored within; sepals lanceolate, 6–8 (12) mm long, 1.5–2 mm. broad, green to purple, reflexed individually at anthesis; petals 6–12 mm. long, 3–7 mm. broad, pinkish-lavender with or without darker flecks in the lower part or throughout, often red at the base, the limb lanceolate to rhomboid, often obscurely 3-lobed, the claw broad, with a pair of more or less conspicuous rounded or denticulate projections near the base; stamens 8, subtended by conspicuous white or lavender ciliated scales as much as 1.5 mm. long; filaments lavender to purple; anthers pinkish-lavender to purple or red; pollen bluish-gray or cream; stigma white or lavender to purple, 4-lobed, the lobes rounded, less than 1 mm. long; style lavender, at maturity equaling or somewhat longer than the stamens, often deflexed to one side; ovary 8–15 mm. long, puberulent, 4-grooved or nearly terete, nearly sessile or on a pedicel as much as 5 mm. long; immature capsule becoming soft and slimy, usually beaked, the beak as much as 3 mm. long; mature capsule quadrangular, straight to strongly curved, 1–2.5 cm. long, 2–2.5 mm. broad; seeds brown or grayish, sometimes mottled, 1–1.5 mm. long, scaly-echinate, the crest as much as 0.1 mm. long.

Type.—From the Great Falls of the Columbia to the Rocky Mountains, *Douglas* (Lindley Herbarium).

Oenothera rhomboidea Lév., Monog. Onoth. 287. 1908. *Phaeostoma rhomboidea* Nels., Bot. Gaz. 52: 267. 1911.

Clarkia gauroides Dougl. *in* Sweet, Brit. Flow. Gard. Ser. II, t. 379. 1837. Type: grown from seeds collected by *Douglas* in California. Placed in synonomy on the basis of the illustration.

Godetia latifolia Nels. & Kennedy, Proc. Biol. Soc. Wash. 19: 156. 1906. Type: Sierra Valley, Sierra County, California, *Hamlin* in 1904 (Nevada Exper. Sta., Reno).

Phaeostoma atropurpureum Heller, Leafl. W. Bot. 2: 220. 1940. Type: Highway 24, about 2 miles west of Arch Rock Tunnel, Butte County, California. *Heller 15129* (isotype examined, U.C. Berkeley).

Distribution (see fig. 25).—Baja California. Arizona. Gila County. California. Amador, Butte, Calaveras, Contra Costa, Del Norte, Eldorado, Fresno, Glenn, Humboldt, Kern, Lake, Lassen, Los Angeles, Madera, Mariposa, Mendocino, Modoc, Monterey, Napa, Nevada, Orange, Placer, Plumas, Riverside, San Bernardino, San Diego, Santa Barbara, Santa Clara, Santa Cruz, Shasta, Sierra, Siskiyou, Sutter, Tehama, Trinity, Tulare, Tuolumne, Ventura, and Yuba counties. Idaho. Adams, Bannock, Benewah, Blaine, Boise, Bonner, Elmore, Franklin, Kootenai, Latah, Owyhee, and Washington counties. Montana. Mt. Silcox. Nevada. Douglas, Humboldt, Ormsby, Pershing, Storey, and Washoe counties. Oregon. Baker, Crook, Deschutes, Douglas, Grant, Jackson, Jefferson, Josephine, Klamath, Lane, Multnomah, Polk, Wallowa, Wasco, Washington, and Yamhill counties. Utah. Davis, Juab, Piute, Salt Lake, Utah, Washington, and Weber counties. Washington. Chelan, Columbia, Ferry, Klickitat, Okanogan, Pierce, Spokane, Stevens, Walla Walla, and Yakima counties. It has also been reported from the Black Hills of South Dakota (Munz

& Hitchcock, 1929), but no collections were cited, and we have been unable to verify this occurence. *Clarkia rhomboidea* is usually found in open dry sites at the lower margins of the montane forest or sometimes in the adjacent woodland. The material we have collected in central Arizona was associated with an oak woodland.

Representative specimens.—Baja California. Las Juntas, *Orcutt* in 1884. Arizona. Gila County: Matzatzal Mountains, North Peak, *Collom 142;* Devils Canyon, between Miami and Superior, *Nelson 1865.* California Butte County: Jonesville, *Copeland 663.* Calaveras County: Calaveras Big Trees, *Rose 40655.* Del Norte County: Hazelview Summit on Crescent City to Grants Pass Road, *Kildale 5796; Wolf 876.* Eldorado County: Riverton, *Brandegee* in 1908. Fresno County: Pine Ridge, *Hall & Chandler 97.* Glenn County: Hupa Indian Reservation, *Chandler 1339.* Kern County: Grade over Greenhorn Mountains, about 1 mile west of summit of road, Greenhorn Mountain County Park, *Ferris & Bacigalupi 2481A.* Lake County: foothills south of Mt. Sanhedrin, midway between Potter Valley and Hullville, *Heller 5873.* Lassen County: Halls Flat, 3.2 miles southwest of Schoonamaker Lake, *Simontacchi 885.* Los Angeles County: Oakgrove Canyon, Liebre Mountains, *Abrams & McGregor 341.* Madera County: Whiskey Creek, 3.5 miles west of Ellis Meadow, 3.7 miles northeast of South Fork, *Constance 2382.* Mariposa County: near LeConte Memorial, Yosemite Valley, *Abrams 4425.* Mendocino County: along Eel River (South Fork) near Hearst, *Bacigalupi 1560.* Modoc County: Pine Creek Canyon, north end of Warner Mountains, *Alexander & Kellogg 4863.* Monterey County: Stone Canyon, *Condit* in 1910. Nevada County: 3 miles north of Nevada City, *Constance 2287.* Orange County: Santiago Peak, *Munz 7091.* Placer County: Emigrant Gap, *Jones 2719.* Plumas County: Prattville, *Heller 8813.* Riverside County: Strawberry Valley, San Jacinto Mountains, *Hall 2270.* San Bernardino County: Mill Creek Canyon, *Parish 5025.* San Diego County: Descanso, *Epling, et al.*, in 1932. Santa Barbara County: Trail to Zaca Peak, *Eastwood 615.* Santa Clara County: near Isabel Creek, Mt. Hamilton Range, *Ferris 4150.* Shasta County: Burney Spring, *Peirson 10281.* Siskiyou County: Black Butte, north of Sisson, *Heller 12435.* Tehama County: near Log Spring Ranger Station on road from Corning to Covelo, *Bacigalupi 2413.* Trinity County: Hills west of Saylor, *Harris & Tracy 3292.* Tulare County: Middle Tule, *Purpus 5631.* Tuolume County: Mather, *Mason 2150.* Yuba County: Highway to Downieville about 8 miles northeast of Comptonville, *Bacigalupi 1584* Ventura County: Cuyama River, *Clokey & Anderson 6764.* Idaho. Adams County: 5 miles south of Tamarack, *Hitchcock & Muhlick 13863.* Bannock County: Pocatello, *Davis 534.* Blaine County: Ketchum, *Nelson & Macbride 1262.* Boise County: Boise (Clear Creek), *Clark 77.* Elmore County: Atlanta, Boise National Forest, *MacFadden 15491.* Franklin County: Preston, Whitney Hills, *Smith 1793.* Latah County: Valley of Pine Creek, *Sandberg, MacDougal, & Heller 526.* Owyhee County: Silver City, *Macbride 879.* Washington County: Rush Creek, *Jones* in 1899. Montana. Mt. Silcox, *Butler 5091.* Nevada. Douglas County: Spooner, *Baker 1138.* Humboldt County: Water Canyon, north end of Sonoma Range, *Train 234.* Ormsby County: Carson City, *Jones* in 1897. Washoe County: Hunters Creek Road, 7–8 miles southwest of Reno, *Archer 6255.* Oregon. Baker County: Deer Creek, 8 miles southeast of Sumpter, *Peck 10398.* Crook County: Farewell Bend, *Leiberg 482.* Deshutes County: Bend, *Peck 15731.* Douglas County: Umpqua Valley, *Howell 1140.* Grant County: Blue Mountains Hot Springs, Blue Mountains, *Henderson 5634.* Jackson County: 7 miles southwest of Prospect, *Hitchcock & Martin 5005.* Jefferson County: Lake Suttle, *Hitchcock & Martin 4887.* Josephine County: near Waldo, *Thompson 4676.* Klamath County: Deer Springs, Swan Lake Valley, *Applegate 206.* Multnomah County: Portland, *Henderson 349.* Wallowa County: Buckhorn Springs, *Peck 18302.* Wasco County: Bear Springs, Mt. Hood Forest Reserve, *Thompson 5172.* Yamhill County: southwest slope of Parrott Mountain, 3 miles northeast of Newberg, *Nelson 2721.* Utah. Salt Lake County: Wasatch Mountains, *Watson 400;* Dry Canyon near Salt Lake City, *Leonard* in 1884. Weber County: near Ogden, *Coulter 181.* Washington. Chelan County: Slopes of Stuart Ridge, *Thompson 11751.* Columbia County: Blue Mountains, *Horner 204.* Klickitat County: Trout Lake, *Pearson 246.* Pierce County: Mt. Rainier, *Fleet 1234.* Spokane County: 6 miles northeast of Spokane, *Kreager 601.*

Progenies from the following localities have been studied in the experimental garden. California. Butte County: Highway 24, 0.4 mile south of Arch Rock, *757;* 0.8 mile south of Arch Rock, *758.* Fresno County: Shaver Lake, *894.* Lake County: 1.1 miles east of junction of Highway 29 and Lower Lake–Kelseyville Road, *89.* Road to Kelseyville, 1 mile west of junction with Highway 53, *99.* Mariposa County: 2 miles from Wawona Ranger Station on Highway 41, *97.* Mendocino County: U.S. Highway 101, 9.2 miles north of Willets, *77;* U.S. Highway 101, 13.3 miles north of Willets, *83;* Covelo road, just east of U.S. Highway 101, *131.* Nevada County: Highway 20, 1.3 miles north of junction with Highway 49, *61;* Highway 20, 8.7 miles east of junction with Highway 49, *72.* Plumas County: Highway 89, 0.9 mile north of Spring Garden, *740;* Highway 89, 0.15 mile south of Feather River State Fish Hatchery, *737;* Almanor, *896.* San Diego County: Cuyamaca Camp Ground, *514;* Palomar, *906.* San Bernardino County: San Bernardino Mountains, Sky Forest, *897.* Trinity County: U.S. Highway 299, 6.6 miles west of Trinity County line, 1 mile east of Grass Valley Creek Bridge, 5–18, *403.* Tulare County: Long Meadow Creek, about 2 miles above junction with Bone Creek, Kern River drainage, *55;* 4.2 miles west of Cabin Cove entrance to Sequoia National Park, *145, 147;* 3.4 miles west of Cabin Cove entrance to Sequoia National Park, *150;* 1.8 miles east of Silver City on road to Mineral King, *152.* Tuolumne County: Cottonwood Trail near Hog Ranch, Mather, *95, 101;* south side of Hetch Hetchy Dam, *114;* 4.7 miles north of entrance to Yosemite Park on Big Oak Flat Road, *121;* Hog Ranch Cabin, Mather, *122;* Highway 120, 5.2 miles west of South Fork Bridge, *129.* Berkeley Tuolumne Camp, *763.* Ventura County: Thorn Meadow, South Fork of Piru Creek, *37.* Idaho. Kootenai County: U.S. Highway 95, 11.4 miles north of Lake Creek Bridge at Ford, *888.* Latah County: 3 miles northeast of Moscow, *633.*

The haploid chromosome number is 12, determined from root tips or microsporocytes of one or more individuals from progenies of each of the following populations: *61, 72, 77, 99, 101, 114, 122, 131, 145, 147, 514, 633, 757, 763, 888, 894,* and *897.* In addition, microsporocytes of one or more individuals have been examined from buds collected in the wild at the following locations in California. Butte County: reservoir near De Sabla, 0.5 mile north of bridge over Little Butte Creek, *398B;* Oroville-Magalia Road, 1.6 miles south of road to Paradise, *824.* Santa Barbara County: San Rafael Mountains, 0.7 mile north of Cachuma Guard Station, *768.* Tulare County: 7.3 miles east of Hospital Rock Camp, *612;* Highway 180, 3.4 miles west of Generals Highway, *613;* Highway 65, 0.5 mile south of junction with Highway 80, *615.* Tuolumne County: Big Oak Flat Road, 3.4 miles east of Stanislaus National Forest boundary, *691;* 1.3 miles south of Evergreen Lodge at Mather, *693;* vicinity of Hog Ranch, Mather *694, 696, 697.*

Clarkia rhomboidea is an allotetraploid species derived from *C. virgata* and *C. mildrediae.* In general, *C. rhomboidea* is morphologically intermediate between the two parental species. At the same time, it is morphologically much more variable than either of them and has a far greater area of distribution. However, *C. rhomboidea* differs in one respect from both of its progenitors; its flowers are usually smaller. These small flowers are predominantly self-pollinated. The style is no longer than the stamens and the stigma is receptive at the time pollen of the same flower is shed. In contrast, the flowers of both parental species are generally larger, protandrous, and the stigma is held away from the anthers. Although *C. rhomboidea* is generally intermediate, the variation with respect to any given trait is sufficiently great to overlap that of both of the diploid species. One may find *virgata*like and *mildrediae*-like populations with respect to particular characters. For example, one herbarium collection from Farewell Bend, Crook County, Oregon (*Leiberg 482*), suggests *C. virgata* in habit, although it is far out of range for this species. The leaves are narrow (3 cm. long, 7 mm. broad) and the rachis of the inflorescence becomes erect several internodes above the uppermost flower. The flowers, however, are typical for *C. rhomboidea.* One population of *C. rhomboidea* (*131*) grown in the garden also suggested *C. virgata* with respect to the habit of the inflorescence. Variation in the direction of one or the other parent is not, however, necessarily correlated with the proximity to the parental species concerned.

Populations of *C. rhomboidea* consisting entirely of depauperate individuals with only one or two flowers each are frequently found, particularly near the ecological limits of distribution. Seeds from these populations, however, produce plants of normal size in the garden.

One plant from locality *694* had 25 chromosomes (Lewis, 1951). No other cytological abnormalities or irregularities have been observed except in interpopulational hybrids. In no case has there been any suggestion that "9 and 18 are the normal numbers," as reported by Johansen (1929*a*).

Relationship.—As indicated above, *C. rhomboidea* is an allotetraploid species derived from *C. virgata* (n = 5) and *C. mildrediae* (n = 7).

Clarkia rhomboidea was placed with *C. unguiculata* in the subgenus Phaeostoma by Munz and Hitchcock (1929). These two species do bear a superficial resemblance to each other as dried specimens, but in morphological details they are very different. To mention only some of the more conspicuous differences, the claw of the petal of *C. rhomboidea* is broad and lobed near the base, whereas that of *C. unguiculata* is slender and normally entire. The color patterns of the petals are conspicuously different. The stamens of the former are subtended by conspicuous scales, which are absent in the latter. The ovary of *C. rhomboidea* is 4-grooved or terete and ripens through a soft, slimy stage in contrast to the 8-ribbed ovary of *C. unguiculata* which dries without becoming notably slimy. The former has puberulent stems, which are recurved at the tips, whereas those of the latter are glabrous, glaucous, and straight. The leaves differ in texture and conformation. Furthermore, they differ conspicuously in chromosome number which of itself suggests that the relationship is not close.

Section Clarkia

Erect herbs; stems usually branched, glabrate or puberulent; rachis of the inflorescence erect or bent to one side, becoming erect as the flowers open; hypanthium campanulate, 3–5 mm. long, minutely puberulent within in the upper half; sepals remaining united and deflexed to one side at anthesis; petals conspicuously 3-lobed, the lobes about equal in length, the claw with a prominent pair of lateral teeth; stamens 8, in two unlike series, the inner sterile, greatly reduced, the outer fertile, subtended by oblong scales; anthers obtuse; ovary 8-grooved.

Type species.—*C. pulchella* Pursh.

Relationship.—This section is apparently of alloploid origin and probably combines genomes from Section Eucharidium and Section Myxocarpa.

31. **Clarkia pulchella** Pursh, Fl. Am. Sept. 1: 260. 1814. (Fig. 26, *a*.)

Erect, as much as 5 dm. tall; stems simple to diffusely branched, glabrate to puberulent; leaf blades linear to lanceolate, occasionally oblanceolate, entire or essentially so, 2–8 (10) cm. long, 2–11 mm. broad, glabrate to sparsely puberulent, sessile or with petioles as much as 1 cm. long; rachis of the inflorescence erect or bent to one side, becoming erect as the flowers open; hypanthium 3–5 mm. long, minutely puberulent within in the upper half, not conspicuously colored within; sepals green or reddish, lanceolate, 10–25 mm. long, 1–3 mm. broad, remaining united and deflexed to one side at anthesis; petals bright pink to lavender, sometimes white or purple-veined, 1–3 cm. long, 5–25 mm. broad, the limb 3-lobed, the lobes approximately equal in length, the lateral lobes usually narrower than the central lobe, the claw conspicuous, with a prominent pair of lateral teeth 1–5 mm. long near the middle; stamens 8, in two unlike series, the inner sterile, greatly reduced in size, the outer fertile, subtended by oblong puberulent scales as much as 1 mm. long; anthers white

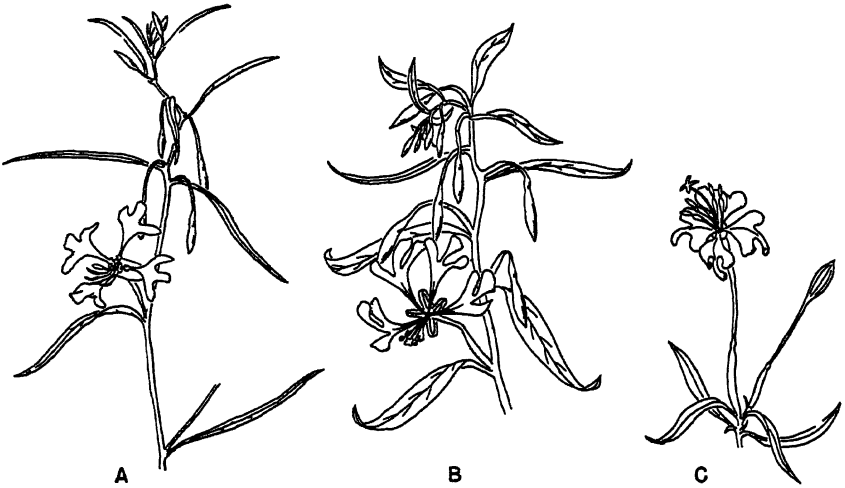


Fig. 26. *a*, *Clarkia pulchella*, inflorescence × ½; *b*, *C. concinna*, inflorescence × ½; *c*, *C. breweri*, inflorescence × ½.

to lavender, reflexing after dehiscence; pollen white; filaments lavender to purple; stigma white, conspicuously 4-lobed, the lobes elliptical to broadly obovate, often overlapping; style exceeding the stamens at maturity, lavender shading to white above; ovary puberulent, shallowly 8-grooved, 5–20 mm. long, on a pedicel as much as 10 mm. long; mature capsule quadrangular, straight or curved, 10–30 mm. long, 1.5–3 mm. broad; seeds dark brown, about 1 mm. long, scaly, the crest about 0.1 mm. long.

Type.—"On the Kooskoosky and Clarck's Rivers" (now Kamiah, Idaho), *M. Lewis*. The type specimen has not been examined. On the basis of the original description and illustration there can be no doubt as to the species intended.

Clarkia elegans Poir., in Dict. Sc. Nat. 9: 355. 1817. *Oenothera pulchella* Lév., Monog. Onoth. 288. 1908.

Distribution (see fig. 27).—British Columbia (southern). Idaho Ada, Adams, Benewah, Bonner, Clearwater, Elmore, Idaho, Kootenai, Latah, Nez Perce, Owyhee, Payette, Shoshone, and Washington counties. Montana. Flathead, Lake, Missoula, and Ravalli counties. Oregon. Baker, Crook, Grant, Harney, Hood River, Malheur, Multnomah, Sherman, Umatilla, Union, Wallawa, Wasco, and Wheeler counties South Dakota. Meade County Washington. Adams, Asotin, Columbia, Douglas, Ferry, Franklin, Garfield, Klickitat, Lincoln, Okanogan, Pierce, Spokane, Stevens, Walla Walla, Whitman, and Yakima counties. There is one record from California, "Plumas County" *Austin* in 1880 (Greene Herbarium, Notre Dame). This specimen, however, may have been cultivated. Usually found in open sites, often in coniferous forest, frequently on shallow soil.

Representative specimens.—British Columbia. Anarchist Mountain, east of Lake Osooyoos, *Thompson 14405;* near International Boundary, between Kettle and Columbia rivers, *Macoun 64602.* Idaho. Boise County: Boise, *Clark 37.* Idaho County: summit of White Bird Grade, above White Bird, *Constance 1937.* Kootenai County: Palouse Country about Couer d'Alene, *Aiton* in 1892. Nez Perce County: Clearwater River, *Heller 3154.* Shoshone County: Wallace, *Palmer 37789a.* Washington County: 18 miles below Weisner, *Jones 6321.* Montana. Flathead County: Big Fork, *Jones* in 1904. Missoula County: Cliffs above Missoula River about 20 miles east of Missoula, *Hitchcock & Muhlick 9091.* Oregon. Sherman County. Mouth of river, John Day Valley, *Henderson 5404.* Umatilla County: Pendleton, *Heller 10176.* Wallowa County: Hat Point Road, 15 miles southeast of Imnaha, *Ownbey 1833.* Wheeler County: 16 miles east of Mitchell, *Applegate 6194.* South Dakota. Meade County: Black Hills, near Fort Meade, *Forwood 124.* Washington. Ferry County: Between Tonasket and Republic, *Thompson 7151.* Lincoln County: South side of

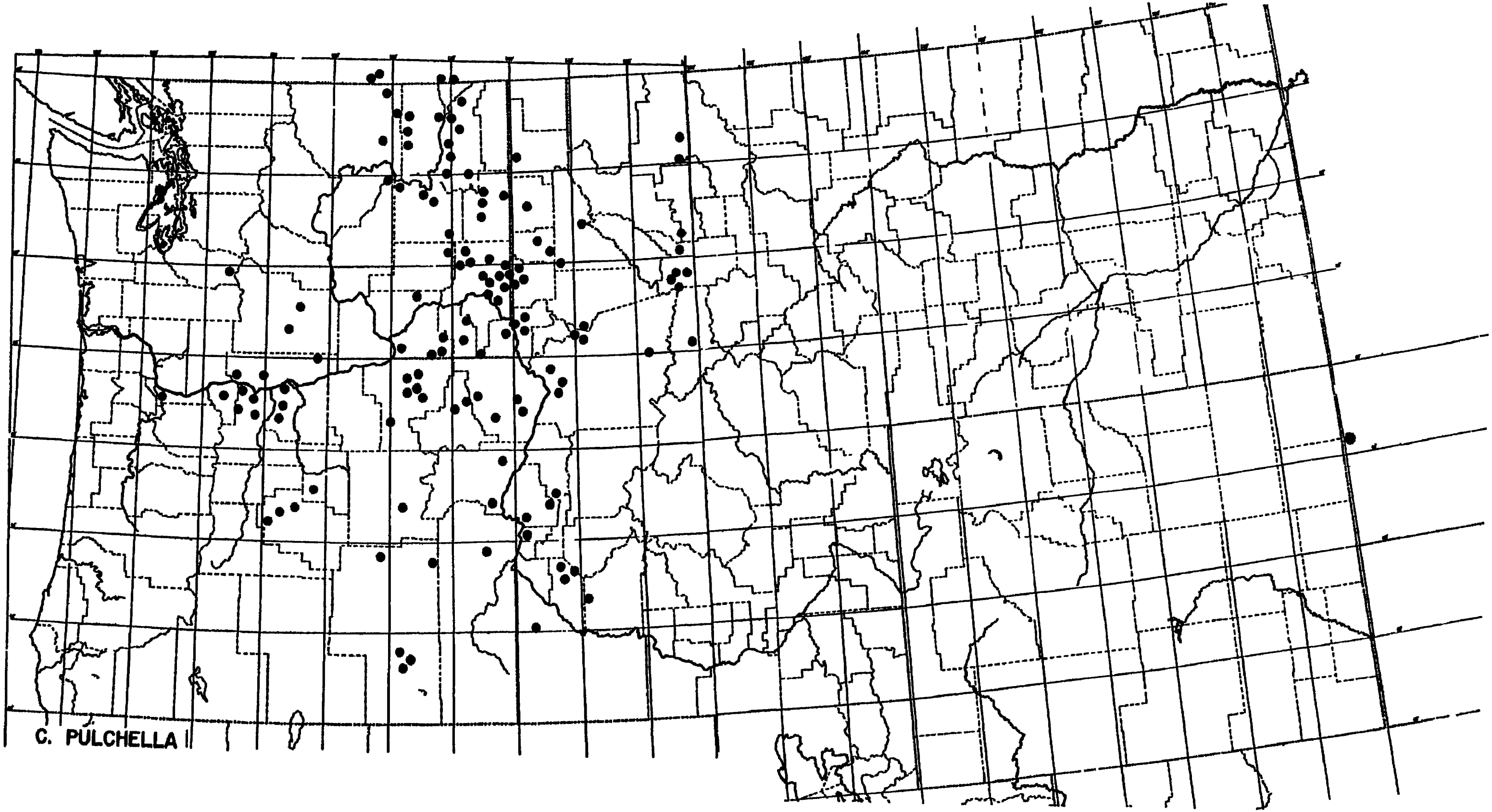


Fig. 27. Distribution of *Clarkia pulchella*.

Columbia River, 3 miles above Grand Coulee Dam, *Rogers 464;* south side of Columbia River at Keelers Ferry, *Rogers 472.* Okanogan County: Slopes east of Omak, *Fiker 700.* Spokane County: Clarks Springs, 10 miles north of Spokane, *Kreager 15.* Stevens County: 2 miles north of Gifford, *Rogers 625.* Whitman County: Pullman, *Piper 1630.*

Progenies from one wild population have been studied in the experimental garden. IDAHO. Latah County: U.S. Highway 95, 5.9 miles north of Moscow, *889.* In addition, we have grown progenies from seeds obtained from the Botanical Garden of the State College of Washington, Pullman, *87.*

The haploid chromosome number is 12 (Håkansson, 1931). We have examined root tips and microsporocytes of individuals from progenies of *87* and *889*, respectively. No meiotic abnormalities were observed. We have found no basis for Johansen's (1929*a*) report of variable chromosome number of 4 to 14 haploid and 8 to 16 diploid nor for the "tentative conclusion that the normal haploid number is 7."

Herbarium material indicates a considerable variation in habit and flower size as well as differences in petal conformation and color (i.e., white-flowered individuals are not uncommon in herbaria). We have had no opportunity, however, to study the nature of this variation in wild populations. Much of the variation in habit may be environmentally induced. For example, the one population of this species we have observed in the wild (*889*) consisted of depauperate plants with only one or two flowers. However, seeds from this population produced normal large plants in the garden. But variation in flower size is not necessarily correlated with the vigor of the individuals. Some herbarium collections have exceptionally large, showy flowers with petals 3 cm. long or longer and the lobes broad (e.g., 5 miles south of Grangeville, *St. John 8030*, and summit of White Bird Grade, above White Bird, Idaho County, Idaho, *Constance 1937;* Steen Mountains, 7 miles southeast of Frenchglen, Harney County, Oregon, *Peck 21462;* 1 mile northeast of Columbia Falls, Flathead County, Montana, *Rogers 974*). Other collections consisting of vigorous plants have much smaller flowers with petals 1–1.5 cm. long and very narrow lobes (e.g., Dufin, Wasco County, *Gorman 5767* and Hood River, Oregon, *Henderson 348;* 3 miles northeast of Macall, Washington, *Jeffrey* in 1946). Some collections (e.g., *Suksdorf 7043*) show considerable range in size.

Genetic studies of flower color determined by single factors have been reported by Rasmuson (1920).

Relationship.—*Clarkia pulchella* has a chromosome number which suggests that it is polyploid. Examination of the morphological characters of *C. pulchella* indicates that it combines traits of Section Euchardium and Section Myxocarpa. For example, *C. pulchella* has the following traits, which are characteristic of Section Myxocarpa: a short campanulate hypanthium, scales at the base of the stamens, and a pair of lateral projections on the claw of the petal. Furthermore, the last two traits occur only in Section Myxocarpa and *C. pulchella.* At the same time, *C. pulchella* is like Eucharidium in the habit of the inflorescence, the position of the sepals at anthesis, and the 3-lobed limb of the petal. In addition, *C. pulchella* is intermediate with respect to other characters, such as habit and stamens. Eucharidium has 4 stamens and Myxocarpa 8, whereas *C. pulchella* has 4 fertile stamens and 4 staminodia. Furthermore, the haploid chromosome number of 12 in *C. pulchella* could be derived from a species in Eucharidium with 7 chromosomes and one in Myxocarpa with 5. The only species known with a genome of 5 is *C. virgata* (Myxocarpa), whereas the most probable contributor of the genome of 7 is *C. concinna* (Eucharidium). These two species, however, are not known to occur together, nor does either grow within the distribution area of *C. pulchella*. The distributions of *C. pulchella* and its possible parents suggest that it is not a recent polyploid. The precise diploid progenitors may no longer be extant. If this is true, *Clarkia virgata* and *C. concinna* are probably the modern derivatives of the actual ancestors of *C. pulchella*.

Munz and Hitchcock (1929) relate *C. pulchella* to *C. xantiana*. If one disregards the lobed petals of *C. xantiana*, however, the differences in their morphological details become much more conspicuous than their similarities. Furthermore, the 3-lobed petal of *C. pulchella* and the 2-lobed petal of *C. xantiana*, with a subulate tooth in the sinus, are not necessarily genetically homologous.

SECTION EUCHARIDIUM SEC. NOV.

Erect herbs; stems usually branched, puberulent, or glabrate but not glaucous; leaves entire or essentially so; rachis of the inflorescence erect or bent to one side in bud; buds often deflexed, becoming erect as the flowers open; hypanthium slender, 13-35 mm. long, the ring of hairs absent; sepals remaining united and deflexed to one side at anthesis; petals conspicuously 3-lobed, the middle lobe equaling or exceeding the length of the lateral lobes; stamens 4; anthers ciliate, obtuse; ovary subterete, sessile.

Type species.—*C. concinna* (Fisch. & Mey.) Greene.

Eucharidium, as a genus, Fischer & Meyer, Ind. Sem. Hort. Petrop. 2: 37. 1835; Eucharidium, as a subgenus, Jepson, Fl. W. Mid. Calif. 331. 1901.

Relationship.—This section represents the greatest morphological deviation from the probable ancestral type of the genus. The stamens have been reduced to 4, the hypanthium has become greatly elongated and the petals are conspicuously 3-lobed. These differences are of a magnitude to warrant generic recognition of Eucharidium were it not for the fact that it is almost certainly linked to Section Myxocarpa by way of the alloploid Section Clarkia. Eucharidium, despite its morphological divergence, has retained the original basic chromosome number of 7.

32. **Clarkia concinna** (Fischer & Meyer) Greene, Pittonia 1: 140. 1887.
(Fig. 26, *b*.)

Erect, as much as 4 dm. tall; stems simple to diffusely branched, puberulent with short, upwardly curled hairs or glabrate; leaf blades lanceolate to elliptic or ovate, entire or subentire, 2–4.5 cm. long, 6–20 mm. broad, glabrous to sparsely puberulent, narrowed to petioles 5–25 mm. long; rachis of the inflorescence erect or bent to one side, becoming straight as the flowers open; hypanthium slender, red, 13–25 mm. long, sometimes deflexed in bud, not conspicuously colored within, the ring of hairs absent; sepals linear or narrowly oblanceolate, 1–2 cm. long, 1–2 mm. broad, remaining united at the tips at anthesis, deflexed at the middle, the distal half thin, red, the basal half thicker and petaloid; petals deep bright pink, often streaked with white and purple, 1–2.5 cm. long, 4–12 mm. broad, narrowed at the base to a more or less conspicuous claw, 3-lobed, the middle lobe spatulate, the lobes about equal in length or the middle lobe longer; stamens 4, equal, filaments pinkish-lavender; anthers red to lavender, ciliate, curling after dehiscence; pollen bluish; stigma 4-lobed, the lobes short, rounded; style exceeding the stamens at maturity; ovary puberulent, 1–2 cm. long, sessile; immature capsule 8-grooved; mature capsule straight or somewhat curved, quadrangular, 1.5–2 cm. long, 2 mm. broad; seeds reddish-brown, 2–3 mm long, scaly, the crest conspicuous, as much as 0.8 mm. long.

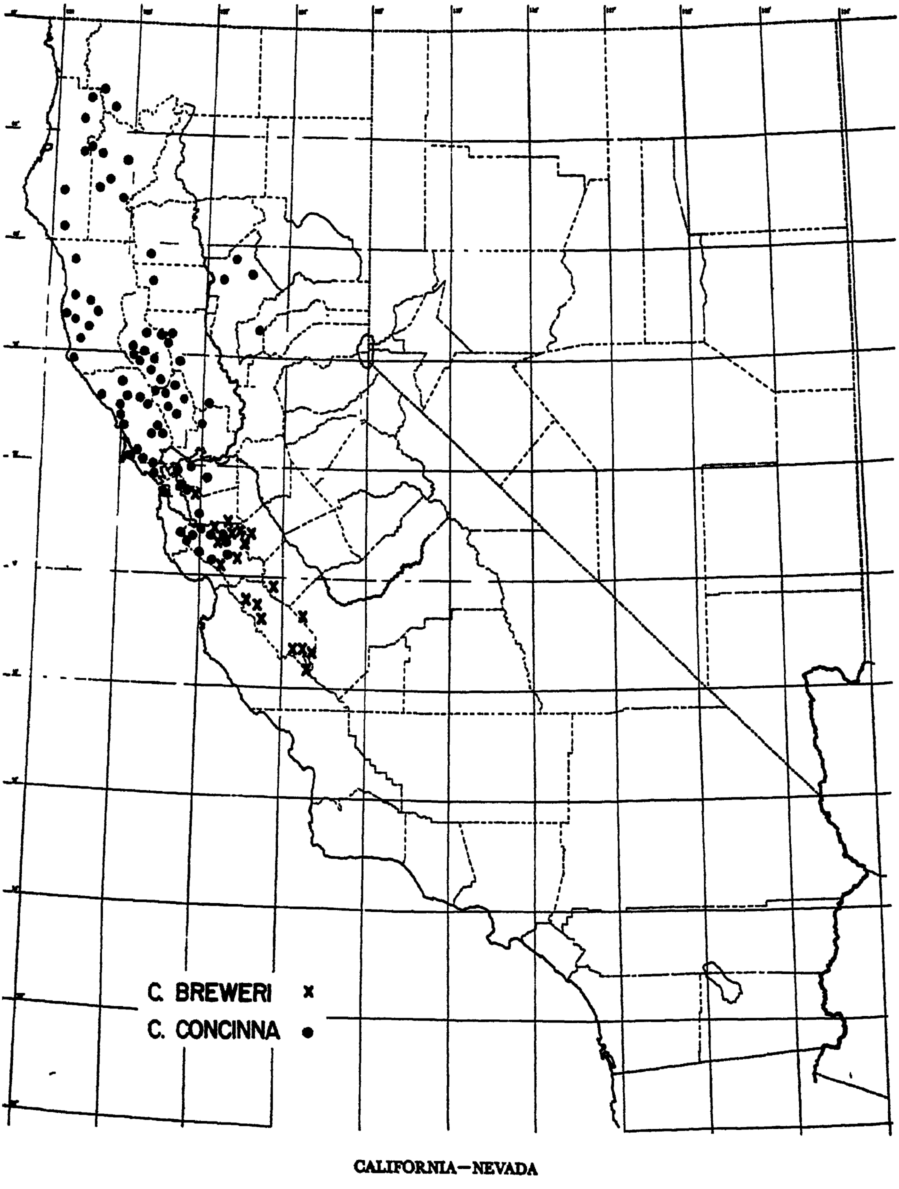
Type.—Based on the type of *Eucharidium concinnum* Fischer & Meyer, Fort Ross, Sonoma County, California. The type specimen, presumably at Leningrad, has not been examined. The original description leaves no doubt as to the species intended.

Eucharidium concinnum Fischer & Meyer, Ind. Sem. Hort. Petrop. 2: 37. 1835.

Eucharidium grandiflorum Fischer & Meyer, Ind. Sem. Hort. Petrop. 8: 48. 1840. Type: near Fort Ross, California. The type specimen has not been examined. Placed in synonomy on basis of description. *Clarkia grandiflora* Greene, Fl. Francisc. 223. 1891.

Distribution (see fig. 28).—CALIFORNIA. Alameda, Butte, Colusa, Contra Costa, Glenn, Humboldt, Lake, Marin, Mendocino, Napa, San Francisco, San Mateo, Santa Clara, Siskiyou, Solano, Sonoma, Tehama, Trinity, Yolo, and Yuba counties. Openings in the woodland and coastal forest of the Coast Ranges and the northern Sierra Nevada.

Representative specimens.—CALIFORNIA. Alameda County: Alameda Creek Canyon, 2-4 miles west of Sunol, *Constance* 2233. Butte County: 22 miles east of Oroville-Feather River Highway,



CALIFORNIA—NEVADA

Fig. 28. Distribution of *Clarkia concinna* and *C. breweri*.

just east of Jarboe Pass, *Heller 15114*. Colusa County: 1 mile east of Lake County line, west of Wilbur Springs, *Keck 2401*. Contra Costa County: Mt. Diablo, *Elmer 4336*. Glenn County: grade 9 miles east of Alder Springs, *Heller 11457*. Humboldt County: hills west of South Fork of Trinity River, near mouth, *Harris & Tracy 3265*. Lake County: Borax Lake, *Torrey 94*. Marin County: Lagunitas, *Hall 8500*. Mendocino County: 4 miles east of Boonville, *Rose 39189*. Napa County: Pope Valley Grade from Calistoga, *Brandegee* in 1909. San Mateo County: Stevens Creek Canyon, *Wight 210*. Santa Clara County: 27-mile Drive near Congress Springs, *Heller 7412*. Siskiyou County: Hawkins Bar on Salmon River, *Kildale 9202*. Solano County: Weldon Canyon, *Jepson* in 1891. Sonoma County: near Mark West Spring, *Mexia 2394*. Tehama County: hills west of Saylor, *Harris & Tracy 3288*. Yolo County: Cache Creek Canyon, *Greene 2982*.

Progenies from the following localities have been studied in the experimental garden. Colusa County: 3.9 miles west of Leesville, *881*. Sonoma County: 0 7 mile west of Mark West Spring, *868*. Trinity County: Douglas City–Hayfork Road, 1.4 miles north of Trinity National Forest boundary, *407*.

The haploid chromosome number is 7 (Schwemmle, 1926; Johansen, 1929*a*). We have examined material from Trinity County (*407*) and Colusa County (*881*). No meiotic irregularities have been observed. The chromosomes are relatively large.

The leaves of wild populations vary considerably in shape, particularly with respect to the ratio of length to breadth. This variation, however, is greatly reduced in the garden which suggests that it may be environmentally induced. The unique ribbonlike, 3-lobed petals are relatively uniform as to shape and color throughout the range of the species, but they may be variously arranged in the flower. They may be spaced equally to form a cross, or grouped in lateral pairs (apparently the principal basis for describing *E. grandiflorum*), or three of the petals may be grouped above with one petal directed downward. Considerable variation in the orientation of the petals, however, can be found on a single plant. In general, they tend to be arranged in lateral pairs.

Relationship.—Clarkia concinna is closely related to *C. breweri*, but the two are readily distinguished from each other by the bright-colored slender petals of the former. Furthermore, *C. concinna* is unique in having the lower half of the sepal petaloid.

Clarkia concinna, or a species much like it, probably gave rise to the alloploid species *C. pulchella* following hybridization with a species similar to *C. virgata* in Section Myxocarpa (see *C. pulchella*).

33. **Clarkia breweri** (Gray) Greene, Pittonia 1: 141. 1887. (Fig. 26, *c*.)

Erect or decumbent, as much as 2 dm. tall; stems usually branched, the branches often equaling the main stem, glabrate or sparsely puberulent with short, upwardly curled hairs; leaf blades lanceolate to linear, entire, 2–5 cm. long, 1–7 mm. broad, glabrate to sparsely puberulent, narrowed to petioles as much as 18 mm. long; rachis of the inflorescence erect or bent to one side, becoming straight as the flowers open; hypanthium slender, 20–35 mm. long, 1 mm. broad, deflexed in bud, not conspicuously colored within, the ring of hairs absent; sepals green to magenta, linear-oblanceolate, not petaloid in the lower half, 1.5–2.5 cm. long, 2.5–4 mm. broad, remaining united and deflexed to one side at anthesis; petals pink, paler or white at the base, 1.5–2.6 cm. long, scarcely clawed, 3-lobed, the two outer lobes broad, the inner longer, linear to spatulate; stamens 4, equal; filaments strongly clavate, white, becoming pink as the pollen is shed; anthers red and yellow striped, becoming dark purple, conspicuously white ciliate; pollen pinkish-blue; stigma 4-lobed, the lobes linear, white, 2–3 mm. long; style pink, exceeding the stamens at maturity; ovary puberulent, subterete, 1.5–2.5 cm. long, sessile; mature capsule straight or somewhat curved, 1.5–4.0 cm. long, 2–3 mm. broad, quadrangular; seeds reddish-brown, 2–3 mm. long, scaly-tuberculate, the crest conspicuous, as much as 0.7 mm. long.

Type.—Based on the type of *Eucharidium breweri* Gray. Dry summit of Mt. Oso at an elevation of about 3,200 ft., Stanislaus County, California, *Brewer 1247* (U.S. National Herbarium).

Eucharidium breweri Gray, Proc. Am. Acad. 6: 532. 1865. *Oenothera eucharidium* Lév., Monog. Onoth. 332. 1908.

Clarkia saxeana Greene, Pittonia 1: 140. 1887. Type: near the Geysers in Napa County, California, *Saxe* in 1872 (Cal. Acad.).

Distribution (see fig. 28).—CALIFORNIA. Alameda, Fresno, Merced, Monterey, San Benito, Santa Clara, and Stanislaus counties. Talus or dry slopes, in oak-digger pine woodland or chaparral of the inner South Coast Ranges. The type specimen of *C. saxeana* Greene was "obtained near the Geysers in Napa County." It is certainly referable to *C. breweri*, but we have seen no other record from north of San Francisco Bay.

Representative specimens.—CALIFORNIA. Alameda County: road from Mt. Hamilton to Livermore, *Eastwood 12473*. Fresno County: Cerro Bonito Mine, Panoche, *Gilmore* in 1874. Merced County: north fork of Los Banos Creek, 0.25 mile northwest of North Peak of Twin Peaks, *Constance & Morrison 2593*. San Benito County: 1 mile south of Idria, *Constance & Morrison 2250;* headwaters of San Benito River, *Hall 9939*. Santa Clara County: Mt. Hamilton, *Elmer 4464*. Stanislaus County: Arroyo del Puerto, 0.5 mile below mouth of Deer Park Canyon, *Carter 1166*.

We have studied one wild population and have grown several progenies from it in the garden (Stanislaus County: Del Puerto Road to Patterson, 5.9 miles from the Mt. Hamilton to Livermore Road, *508*).

The haploid chromosome number is 7, based on root-tip counts of two individuals from population 508. The chromosomes are comparable in size to those of *C. concinna.*

Clarkia breweri is morphologically very distinct and apparently relatively uniform throughout its restricted area of distribution.

Relationship.—*Clarkia breweri* is very closely related to *C. concinna*. These two species can be readily distinguished by the conformation of the petals. The lateral lobes of the petals of *C. breweri* are broad, and the petals overlap in such a way that the flowers appear square. In contrast, the ribbonlike petals of *C. concinna* are frequently zygomorphically arranged. Furthermore, the sepals of *C. breweri* are not at all petaloid and the filaments of this species are conspicuously clavate. *Clarkia breweri* occupies much drier sites than *C. concinna*, which suggests that it may be of more recent derivation (Lewis, 1953*b*).

EXCLUDED NAMES

Godetia heucki Phil., Anal. Univ. Chile 84: 743. 1893. It is referable to *Oenothera rosea* Aiton.

Godetia pulcherrima Greene, Pittonia 2: 217. 1891. Type: Los Angeles County, *Mrs. W. F. Wheeler.* The type specimen can not be found and the description is not definitive. The description of the flower fits *C. dudleyana* (Abrams) Macbride but the description of the capsule excludes this species and suggests *C. deflexa* (Jeps.) Lewis & Lewis.

Clarkia romanzovii Nels. & Macbr., Bot. Gaz. 65: 63. 1918. *Godetia romanzowii* Spach, Hist. Veg. Phan. 4: 390. 1835. Based on *Oenothera romanzovii* Ledeb. *ex* Hornem., Hort. Hafn. Suppl. 133. 1819. The description is not definitive and we have seen no specimens which were definitely authentic (see Hitchcock, 1930, p. 360).

APPENDIXES

APPENDIX I

CYTOLOGICAL TECHNIQUE

ROOT TIPS are fixed in CRAF or 2BE and stained with crystal violet after sectioning, or fixed in 1:3 acetic alcohol and squashed in aceto-lacmoid or aceto-carmine. For microsporocyte analysis, whole buds are fixed in 1:3 acetic alcohol and stored in 70 per cent alcohol in a refrigerator. The buds are subjected to a strong hydrolysis before the anthers are squashed in order to remove numerous large granules, in the cytoplasm of the microsporocytes, which obscure the chromosomes. Two methods have been successful. (1) Buds are placed in 2 per cent chromic acid for six to twenty-four hours and then hydrolysed in 3N HCl at 60° C. for seventeen to twenty minutes. Following hydrolysis the buds are stained in leuco-basic fuchsin for fifteen to thirty minutes before squashing the anthers in a drop of 50 per cent acetic acid. (2) Buds are hydrolysed in a mixture of equal parts of concentrated HCl and 95 per cent ethyl alcohol for fifteen minutes at room temperature. Following hydrolysis the anthers are squashed in a drop of aceto-carmine and heated until the cytoplasm of the microsporocytes becomes clear. We are indebted to Richard Snow for this second method.

All of the anthers of a flower undergo meiosis at approximately the same time in our material. Consequently, one bud at the proper stage provides an abundance of material. Using the first method, the anthers are differentially stained by the leuco-basic fuchsin, and those undergoing meiosis can be easily selected without microscopic examination. These anthers have bright magenta, well-differentiated packets of sporogenous tissue. Older anthers are a duller brownish-red, whereas anthers that are too young for meiotic stages are paler and do not have well-differentiated packets of sporogenous tissue. With the second method, anthers containing young pollen grains become bright yellow; the anthers of younger buds remain white. Both methods often result in unsatisfactorily stained preparations. Using the first method but squashing the anthers in a drop of aceto-lacmoid or aceto-carmine and gently heating them after they have been in leuco-basic fuschin twenty to thirty minutes usually improves staining. However, even poorly stained preparations can be critically examined with a phase-contrast microscope equipped with dark-contrast objectives. We have circumvented our staining difficulties in recent years in this way.

APPENDIX II

NAMES USED FOR SPECIES OF CLARKIA IN CYTOLOGICAL AND GENETICAL PAPERS

SPECIES USED for genetical and cytological work in the genus *Clarkia* have frequently appeared under a taxonomically incorrect name or have been referred to another genus. The names used by various authors are shown below together with the specific name of the equivalent taxon in the present treatment. The papers involved are included in the literature cited (p. 371). The abbreviations *G.* and *E.* refer to *Godetia* and *Eucharidium.*

Clarkia Species	Name Used	Author
amoena	*G. whitneyi*	Chittenden Håkansson Hiorth
	G. amoena (in part, see *C. rubicunda*)	Johansen
	G. grandiflora	Johansen
arcuata	*G. hispidula*	Håkansson Hiorth
biloba	*G. biloba*	Håkansson Hiorth
	G. "biloba"	Hiorth
bottae	*G. bottae*	Håkansson Hiorth
concinna	*E. concinnum*	Schwemmle
cylindrica	*G. cylindrica*	Håkansson Hiorth
deflexa	*G. bottae*	Chittenden Håkansson (before 1940)
	G. deflexa	Håkansson Hiorth
gracilis	*G. nutans*	Håkansson Hiorth
purpurea	*G. lepida*	Chittenden
	G. purpurea	Håkansson Hiorth
	G. quadrivulnera	Håkansson Hiorth
	G. "quadrivulnera"—Placerville	Hiorth
rubicunda	*G. amoena*	Chittenden Håkansson Hiorth Johansen
speciosa	*G. parviflora*	Håkansson Hiorth
tenella	*G. tenella*	Chittenden Håkanson
	G. "tenella"	Hiorth
	G. "dasycarpa"	Håkansson Hiorth
	G. "lavender gem"	Hiorth
	G. "blauer Zwerg"	Håkansson Hiorth
	G. Chile A	Hiorth
	G. Chile B	Hiorth
unguiculata	*C. elegans*	Geitler Håkansson Lewis Rasmuson
williamsonii	*G. viminea*	Håkansson Hiorth

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Abbreviation	*Species*	*Abbreviation*	*Species*
aff	14. *C. affinis*	*ling*	18. *C. lingulata*
am	1. *C. amoena*	*mil*	28. *C. mildrediae*
arc	3. *C. arcuata*	*mod*	19. *C. modesta*
bil	17. *C. biloba*	*nit*	8. *C. nitens*
bott	15. *C. bottae*	*pros*	12. *C. prostrata*
brew	33. *C. breweri*	*pul*	31. *C. pulchella*
con	32. *C. concinna*	*pur*	13. *C. purpurea*
cyl	16. *C. cylindrica*	*rhom*	30. *C. rhomboidea*
dav	11. *C. davyi*	*rub*	2. *C. rubicunda*
def	23. *C. deflexa*	*sim*	22. *C. similis*
del	24. *C. delicata*	*spec*	9. *C. speciosa*
dud	20. *C. dudleyana*	*ten*	10. *C. tenella*
epi	21. *C. epilobioides*	*ung*	25. *C. unguiculata*
exi	26. *C. exilis*	*vir*	29. *C. virgata*
grac	5. *C. gracilis*	*will*	7. *C. williamsonii*
imb	6. *C. imbricata*	*xant*	27. *C. xantiana*
lass	4. *C. lassenensis*		

Abbott, in 1889; *pur;* in 1904 *pros;* in 1906 *dud*

Abrams, G., in 1900 *ung*

Abrams, L., in 1898 *aff;* in 1900 *exi* and *xant;* in 1907 *rub;* 302 *def;* 304 *pur;* 305 *dud;* 713 *pul;* 734 *rhom;* 833 *pul;* 1403 *pur;* 1655 *ung;* 1657 *pur;* 1706 *epi;* 1711 *ung;* 1713 *def;* 1796 *pur;* 2015 *rhom;* 2553 *def;* 2625 *dud;* 3057 *rub;* 3331, 3442 *epi;* 3542, 3688 *pur;* 3710 *del;* 3784, 3821 *pur;* 3839 *rhom;* 3961 *pur;* 4128 *def;* 4425 *rhom;* 4510 *will;* 4681 *dud;* 4708 *bil;* 4709 *will;* 4960 *ung;* 4965 *will;* 4967 *dud;* 5011 *ung;* 5236 *con;* 5357 *cyl;* 5402 *will;* 5641 *pur;* 5676 *cyl;* 5702 *ung;* 5712 *pur;* 5809 *am;* 5853 *rhom;* 5928 *grac* and *am;* 5979, 6020 *am;* 6028 *am* and *pur;* 6162 *am;* 6477 *ung;* 6478 *cyl;* 6487 *spec;* 6488 *pur;* 6519, 6520 *spec;* 6550 *def;* 6617 *ung;* 7140, 7169 *am;* 7298 *bott;* 7530 *con;* 7653 *spec;* 8040, 8048 *pur;* 8105, 8229, 8431 *am;* 8639 *pur;* 8711 *am;* 8735 *pur;* 11958 *ung;* 11989 *cyl;* 11990, 12009 *exi;* 12326 *am;* 12349 *pur;* 12394 *con;* 12523, 12551 *mod;* 13575 *will*

Abrams & Bacigalupi, 8134 *con*

Abrams & Benson, 10366 *grac*

Abrams & Borthwick, 7870 *mod;* 7885 *pur;* 7886 *mod;* 7944 *aff;* 7998 *ung*

Abrams & McGregor, 4 *pur;* 16 *ung;* 45 *pur;* 132 *def;* 151 *epi;* 274, 303 *cyl;* 306 *xant;* 307 *ung;* 341 *rhom;* 398 *pur;* 450 *rhom;* 719 *pur*

Abrams & Wiggins, 9 *epi*

Akey, 45 *pur;* 102, 113 *rub*

Ainslie, in 1873 *pul*

Aiton, in 1892 *pul*

Alderson, in 1893 *pur;* 724 *del*

Alexander & Kellogg, 2942 *xant;* 3716 *arc;* 3618 *pur;* 3670 *vir;* 3708 *bil;* 3617 *arc;* 4738 *grac* and *aff;* 4863 *rhom;* 5692 *con;* 5727 *lass*

Allen, in 1925 *epi*

Ames, in 1875 *grac;* in 1894 *ung*

Anderson, in 1894 *am;* in 1912 *am;* in 1929 *rhom;* 252 *lass*

Angier, 158 *pur*

Angus, 156 *epi;* 158 *pur*

Applegate, in 1894 *rhom* and *lass;* in 1895 *pur* and *ung;* 205 *ung;* 206 *rhom;* 208 *pur;* 209 *lass;* 2322 *pur;* 2353 *grac;* 2371, 2377 *pur;* 2540, 3163 *rhom;* 3512 *grac;* 3581 *lass;* 3652 *rhom;* 4324 *grac;* 4703, 5042 *pur;* 5507, 5744 *rhom;* 5836 *pur;* 5850 *rhom;* 6194, 6503 *pul;* 7197 *grac;* 7246 *pur;* 10604, 11150, 11983 *rhom*

Archer, 6255 *rhom*

Armstrong, 126 *will*

Arnold, in 1922 *ung*

Atkinson, in 1900 *aff* and *pur*

Augsberry, in 1922 *will, dud,* and *ung;* in 1925 *will* and *dud*

Augustine, 164 *dud;* 165 *rhom;* 174 *will;* 177 *rhom*

Austin, in 1880 *lass* and *pul;* in 1883 *arc, grac,* and *pur;* in 1896 *arc* and *pur;* 104 *ung;* 124 *arc;* 216 *rhom;* 226 *pur;* 341 *grac;* 387 *dud;* 848, 851, 1133 *grac;* 1955 *pur;* 1956 *arc*

Axelrod, 490 *pur;* 495 *cyl*

Babcock, 4422 *rhom*

Babcock & Stebbins, 1639, 1732 *lass*

Bacigalupi, in 1924 *pur;* 1146, 1358 *pur;* 1397 *con;* 1506, 1560, 1584 *rhom;* 1857 *pur;* 2401 *con;* 2295 *pur;* 2296 *dud;* 2413 *rhom*

Bacigalupi & Ferris, 2459, 2466 *xant;* 2470 *spec;* 2481A *rhom*

Bacigalupi, Wiggins, & Ferris, 2625, 2649 *rhom;* 2651 *dud;* 6674 *con*

Bacon, in 1902 *will* and *rhom*

Bailey, in 1914 *pul;* 86 *pur*

Baker, C. F., 525 *lass;* 843 *aff;* 859 *pur;* 980 *lass;* 1138 *rhom* 2884 *pur;* 2891 *grac;* 2902, 3060 *pur;* 3665 *dud;* 4713 *pur;* 4714 *dud;* 5065, 5066, 5352, 5576 *pur*

Baker, M. S., in 1893 *grac, lass,* and *rhom;* in 1895 *pur* and *def;* in 1904 *rhom* and *am,* in 1925 *ung;* 43*b* *will;* 220*a* *rhom;* 252*a* *rub;* 386 *mil;* 525 *rhom;* 594 *ung;* 598 *con;* 670 *grac;* 2550A *pur;* 2982 *con;* 5766 *dud;* 5995 *mod;* 9029, 9030 *pur;* 9791 *dav* and *grac;* 11062, 11107 *imb;* 12250 *grac*

Baker, W. H., 3792 *grac;* 4231 *pur;* 4349 *rhom;* 6108 *pur*

Baker & Eide, in 1930 *am*

Balls, 7926 *pur;* 7940, 13661 *ung;* 13685 *rhom;* 13686 *con;* 15937 *ung*

Balls & Lenz, 15939 *cyl*

Barber, in 1897 *def* and *dud;* in 1899 *pur, def, am* and *aff;* 144 *pur*

Barnhart, 2934 *will*

Barrows, 87, 88 *ten*

Barry, 53, 145 *pur*

Beane & James, 2116 *ung;* 2119 *aff*

Beattie & Chapman, 2004 *pul;* 2119 *rhom;* 2243 *pul*

Beattie & Lawrence, 2423 *pul*

Beckwith, 45 *lass*

Beku, in 1930 *ten*

Belshaw, 41 *will;* 2018A *aff;* 2053 *pur;* 2075 *aff;* 2077, 2112 *pur;* 2113, 2114, 2130 *aff;* 2242A *grac;* 2243A, 2261 *pur;* 2261A, 2262 *rub;* 2288, 2296, 2376, 2377, 2378 *pur;* 2342 *bil;* 2368 *will;* 2465 *rhom*

Benson, in 1932 *rhom;* 42 *con;* 162 *ung;* 172 *bil;* 190 *aff;* 203 *rhom;* 208 *pur;* 246 *am;* 261 *pur;* 262 *rhom;* 269 *grac;* 296 *ung;* 300 *am;* 337*a* *pur;* 346 *ung;* 352 *am;* 354 *con;* 499 *pur;* 1612 *pul;* 1865 *am;* 2121 *pur;* 2122 *rub;* 2723 *mod;* 2758 *pur;* 2794 *dud;* 3311 *mod;* 3344 *exi;* 3373 *cyl;* 3463, 3464 *exi;* 3600 *cyl;* 3620 *bil;* 3625 *xant;* 3632 *spec;* 4510 *rhom;* 5641 *am;* 5805 *mod;* 5806 *pur;* 5827 *def;* 6042 *cyl;* 6114 *rub;* 6124, 6167 *am;* 6657 *pur;* 6662 *con;* 7657 *cyl;* 7690 *will;* 7782, 7902 *rhom;* 7918 *con;* 8134 *cyl;* 8313 *ung;* 8354 *xant;* 8355 *ung;* 11535 *epi*

Bentley, in 1917 *ung* and *pur*

Bertero, 468, 469, 1189 *ten*

Bethel, in 1923 *lass* and *pur*

Bidwell, in 1874 *rhom;* in 1878 *arc, ung,* and *pur;* in 1879 *pur* and *grac;* in 1885 *arc*

Bigelow, in 1853–1854 *ung, pur, mod,* and *con*

Bingham, in 1878 *epi*

Bioletti, in 1891 *pur;* in 1892 *am* and *pur;* in 1893 *con;* in 1900 *will*

Biswell, 57 *will;* 59 *ung;* 149 *pur*

Blankinship, in 1892 *con;* in 1893 *ung, pur,* and *am;* in 1920 *am;* in 1922 *pur;* in 1923 *con;* in 1924 *rhom* and *am;* in 1925 *am;* in 1927 *pur;* in 1929 *pur; ung; rhom,* and *con*

Blasdale, in 1891 *def, ung,* and *con;* in 1893 *am* and *rub;* in 1895 *dud* and *bil*

Bletheu, in 1912 *will*

Blockman, in 1893 *epi*

Bolander, in 1865 *rub* and *pur;* in 1866 *pur* and *ung;* 104 *ung;* 125 *rub;* 282 *pur;* 370, 407 *rub;* 410 *pur;* 1865 *con;* 2538 *pur;* 3935 *con;* 4919 *will;* 6366 *dud;* 6367 *will;* 6370 *ung;* 6534 *am*

Bolt, 3 *pur;* 76 *rhom;* 744 *ung*

Bond, in 1928 *rub* and *def*

Borell, in 1930 *pul*

Botta, in 1829 *bott*

Bowerman, 235 *ung;* 241 *con;* 297 *pur;* 355 *bil;* 799, 843 *pur;* 858 *grac;* 859, 875 *pur;* 879 *con;* 1925, 2095 *aff;* 2122 *pur;* 2123 *aff;* 2252, 2270 *pur;* 2271 *aff;* 2928 *pur;* 3041 *aff;* 3139 *bil;* 3840 *grac*

Bowman, in 1901 *am;* in 1902 *pur;* 68, 114 *con*

Bradshaw, 27 *con;* 50 *pur;* 126 *am;* 1749 *pur*

Brandegee, *K.*, in 1905 *am, rub, pur, cyl, dud, bil, ung, xant, rhom* and *con;* in 1906 *pur, epi sim, del* and *rhom;* in 1907 *rub, arc, grac, pur, aff, dud, con, bil,* and *ung:* in 1908 *am, rub, arc, grac, spec, pur, bott, cyl, bil, will, ung, vir* and *rhom;* in 1909 *grac, spec, pur, cyl, epi, def, ung* and *con;* in 1910 *arc, nit, pur, spec,* and *bil,* in 1911 *spec* and *cyl;* 77 *spec;* 119 *rub;* 120 *grac;* 121, 122, 125 *pur;* 126 *spec*

Brandegee, T. S., in 1886 *bott;* in 1888 *ung;* in 1889 *epi;* in 1892 *con;* in 1894 *pur* and *epi;* in 1903 *sim;* in 1906 *del* and *pur;* 276, 780 *rhom;* 14165 *pul*

Brandegee & Braunton, 124 *def*

Branson, in 1929 *cyl* and *will*

Braunton, in 1902 *pur;* in 1906 *cyl;* 41 *def;* 186 *pur;* 400 *cyl;* 401, 403, 405 *pur;* 617 *rub;* 885 *pur;* 887 *epi;* 895 *dud;* 896 *ung;* 1042 *bil*

Brewer, 1860–62 *rub;* 477, 477*a* *pur;* 490 *ung;* 508 *aff;* 519 *spec* and *pur;* 638 *pros;* 690 *pur;* 754 *rub;* 1247 *brew;* 1276 *ung;* 2538 *pur*

Bridges, 107 *will;* 108 *will* and *am;* 109 *ung;* 110 *con*

Briggs, 1281 *pur*

Bright, 8468 *cyl*

Brown, 212 *pur;* 537 *rhom;* 907 *am*

Browne, in 1896 *ung*

Bruce, in 1897 *ung, grac,* and *arc;* 57 *pur;* 124 *arc;* 1954 *grac;* 1955 *pur;* 1956 *arc;* 2413 *pur;* 2419 *grac*

Brunet, in 1926 *pul*

Bryan, 84 *ung;* 85 *def;* 86 *will*

Buchtein, in 1895 *ten;* 31 *ten*

Bullard, 4 *ung;* 21 *will;* 22 *dud;* 27 *pur*

Bush, in 1880 *pur*

Butler, 556 *pul;* 747 *lass* and *pur;* 926 *rhom;* 1375 *pur;* 1436 *rhom;* 2258, 2261 *pul;* 5091 *rhom;* 7000 *pul*

Cabrera, 5093 *ten*
Caldwell, in 1907 *epi*
Camp, de, in 1912 *pur*
Campbell, 654 *con;* 16078 *def*
Canby, in 1895 *will;* in 1925 *pur*
Cannon, in 1891 *rub, bott,* and *pur;* in 1892 *rub* and *bott;* in 1899 *pur;* in 1900 *aff*
Cantelow, E. D., 559 *pur;* 917 *lass;* 2364 *rhom;* 2464 *con;* 2578 *rhom;* 2626, 4024 *grac;* 4032 *pur;* 4033 *bil;* 4034 *pur;* 4035 *lass*
Cantelow, H. C., in 1935 *rhom;* in 1939 *grac;* in 1940 *pur, ung* and *rhom;* in 1941 *pur* and *dav*
Carlson, in 1905 *epi;* 18 *rub;* 20 *ung;* 70, 316 *pur*
Carpenter, in 1949 *dud*
Carruth, in 1899 *grac;* in 1900 *con*
Carter, A., 1166 *brew*
Carter, E., in 1919 *am;* 11 *mod;* 51, 52 *pur*
Chandler, in 1897 *dud, pur,* and *rhom;* 450 *bott;* 1073, 1325 *con;* 1327 *grac;* 1339 *rhom;* 1363 *grac;* 1471 *pur;* 5082, 5212 *epi;* 5341, 5414 *pur;* 5437 *rhom;* 5787 *grac*
Chapman, 23 *pul*
Chesnut, in 1889 *con;* 40 *pur*
Chesnut & Drew, in 1888 *am* and *pur;* in 1889 *will*
Churchill, in 1900 *dud*
Clar, 115 *bil*
Clark, 37 *pul;* 77 *rhom*
Claude Joseph, 975, 1049, 1245, 1491, 1493, 1789, 3722, 4843, 4844, 5673, 5692 *ten*
Clausen, 1038 *con*
Clear, in 1938 *grac* and *ung*
Cleburne, in 1883 *pul*
Clemens, in 1908 *rhom* and *pul;* in 1909 *rhom;* in 1910 *will* and *ung;* in 1911 *rhom;* in 1919 *will;* in 1920 *rhom*
Clements, 174 *epi;* 175 *pur*
Clency, in 1916 *pur*
Cleveland, in 1874 *epi;* in 1875 *epi* and *del;* in 1877 *ung;* in 1878 *pur;* in 1880 *bil;* in 1882 *am, con, rhom,* and *mod;* in 1981 (!) *sim;* 788 *pur;* 7356, 7357 *epi*
Clokey & Anderson, 6764 *rhom;* 6767, 6769 *pur*
Clokey & Templeton, 4485, 4533 *epi;* 4534 *def;* 4540 *ung*
Cobb, in 1900 *pur;* in 1907 *aff;* 3 *spec;* 10 *pur;* 15 *spec;* 16 *cyl*
Collins & Kempton, 159 *sim;* 162*a pur;* 200, 204 *rhom;* 249 *pur;* 263 *rhom*
Collom, in 1935 *rhom* and *pur;* 142, 462 *rhom*
Condit, in 1908 *cyl, def,* and *ung;* in 1909 *epi;* in 1910 *dud, def, nit, pur,* and *rhom;* in 1911 *pros* and *pur*
Condit & Brandegee, in 1911 *spec*
Congdon, in 1880 *pur* and *con;* in 1882 *bil;* in 1883 *pur* and *mod;* in 1889 *dav;* in 1890 *will;* in 1892 *arc, will* and *rhom;* in 1893 *dud;* in 1894 *will* and *pur;* in 1895 *arc, will, dud, pur,* and *mod;* in 1896 *will, aff, dud,* and *bil;* in 1897 *arc* and *dud;* in 1898 *arc;* in 1901 *dud* and *bil;* in 1903 *bil, dud,* and *cyl;* 15, 39 *will;* 43 *dud;* 44 *cyl;* 187 *mod*
Constance, in 1933 *con;* 528 *rub;* 618 *am;* 619 *pur;* 939 *am;* 1937 *pul;* 2208 *mod;* 2233 *con;* 2287 *rhom;* 2346 *will;* 2348 *dud;* 2377 *ung;* 2382 *rhom;* 2821, 2837 *pur;* 9694 *lass*
Constance & Beetle, 2771 *pur*
Constance & Clements, 1739 *pul*
Constance & Morrison, 2250 *brew;* 2267 *ung;* 2593 *brew*
Constance & Rollins, 1650 *pul*
Constance, Rollins, Dimond, & Worley, 1123 *pul*
Cook, in 1895 *cyl*
Cook & Reynolds, in 1900 *rhom* and *will*
Cooke, 11047, 13685 *rhom;* 15023 *lass;* 15221, 15339 *rhom*
Coombs, in 1911 *sim* and *pur;* in 1916 *will, ung,* and *dud*
Cooper, 351 *pur;* 531 *sim;* 1332 *pur;* 1506, 1507, 8537 *rhom*
Copeland, 105 *rhom;* 515 *ung;* 529 *rub;* 663, 1520 *rhom;* 1611 *ung;* 1612 *pur;* 3332 *rub*
Cortelou, in 1925 *ung*
Cotton, 460, 1024, 1054 *pul*
Coulter, 181 *rhom*
Covel, 36 *rub*
Coville, 506 *pul*
Coville & Funston, 1060 *xant;* 1071 *will;* 1074 *spec;* 1099 *cyl;* 1145 *ung;* 1150 *cyl;* 1151 *xant;* 1182 *rhom;* 1216 *pur;* 1217 *spec;* 1320 *dud*
Coville & Kearney, 210 *pul*
Coville & Leiberg, 125 *rhom*
Craig, in 1941 *pur;* 213 *epi;* 407 *rhom;* 495 *def;* 1380 *spec;* 1381 *cyl;* 1383 *ung;* 1862 *pur*
Crambie, in 1933 *con*
Cramsie, in 1923 *pur*
Crane, in 1935 *rhom*
Crawford, in 1915 *dud* and *pur;* in 1916 *pur* and *epi;* 925 *rhom*
Cronemiller, 3012, 3020 *epi*
Cronkhite, 95 *rhom*
Cronquist, 2046 *rhom*
Crow, in 1930 *dud*
Crum, 1462, 1877 *mod;* 1995 *con;* 2140 *grac*
Culbertson, 4495 *dud;* 4507 *nit*
Cuming, 522 *ten*
Cummings, in 1896 *pur* and *dud*
Cunningham, 9 *ung*
Curran, in 1884 *xant;* in 1886 *con*
Cusick, 2138 *pul;* 3244, 4076, 4094 *grac;* 4196 *am;* 4279 *grac*

Daus, 89 *pur*
Davidson, in 1885 *will* and *ung;* in 1888 *ung;* in 1890 *epi;* in 1892 *ung;* in 1893 *pur;* in 1895 *pur;* 1650 *dud;* 1651 *spec*

Davis, 100 *pul;* 534, 2449 *rhom;* 2082, 3723 *pul*
Davy, in 1896 *rub;* 299 *rub;* 300 *ung;* 718 *con;* 792, 1337, 1367 *pur;* 1407 *arc;* 1408, 1413 *pur;* 1414 *ung;* 1451, 1484, 1532 *bil;* 1533, 1586, 1605 *pur;* 1711 *ung;* 1713 *cyl;* 5312, 5562 *am;* 5728 *grac;* 5731, 6191 *am;* 6701 *dav;* 7394 *pur;* 7595 *spec*
Davy & Blasdale, 5294 *con*
Dawson, in 1885 *am;* 55010 *pul*
Degener & Peiler, 16034 *cyl*
Demarie, 9247 *rub*
Detling, 3026 *am;* 3166 *pul;* 4134 *grac*
Dickson & Drake, in 1886 *pul;* in 1889 *pur*
Dillon, 633 *rhom;* 634 *pul*
Dombey, 730 *ten*
Douglas, in 1830 *am;* in 1833 *bott, spec,* and *ung*
Drew, in 1887 *will* and *bil;* in 1888 *ung*
Drushel, in 1915 *rub* and *am*
Duncan, in 1923 *cyl;* 150, 151 *pur;* 153 *ung;* 355 *am*
Dudley, in 1892 *spec;* in 1893 *brew, con, pur,* and *rhom;* in 1894 *rub* and *pur;* in 1895 *rub, spec, pur, ung,* and *con;* in 1896 *rub* and *ung;* in 1897 *rub, pur,* and *ung;* in 1898 *pur;* in 1899 *am, pur, mod, ung,* and *brew;* in 1900 *pur, dud,* and *ung;* in 1901 *will, pur, bott, bil, cyl,* and *mod;* in 1902 *rub, dud,* and *ung;* in 1903 *rub, pur,* and *ung;* in 1905 *rub* and *pur;* in 1906 *nit* and *pur;* in 1909 *rub* and *pur;* in 1927 *ung* and *def;* in 1935 *spec* and *pur;* in 1936 *cyl;* in 1937 *dud;* 428 *rhom;* 442, 448 *xant;* 550 *spec;* 551 *cyl;* 563 *spec;* 564 *dud;* 571, 886 *ung;* 1376 *dud;* 1753 *rhom;* 1796, 2669, 2684 *dud;* 3335 *ung;* 3400 *dud;* 4021 *ung;* 4026 *pur;* 4029 *con;* 4053 *pur;* 4164 *brew;* 4198 *mod*
Dudley & Lamb, 4445 *cyl;* 4531 *rhom*
Dunkle, 1828 *epi;* 1870 *pur,* 1924 *epi*
Dunn, G. W., in 1890 *rub;* in 1891 *epi* and *pur;* in 1899 *rhom*
Dunn, N., in 1932 *pros*
Durham, in 1942 *cyl* and *ung;* 152 *pur*
Dutton, in 1900 *pur, rub,* and *ung*

Earle, in 1880 *ung*
Eastwood, in 1892 *rhom;* in 1896 *am* and *pur;* in 1900 *am;* in 1901 *ung;* in 1906 *will;* in 1909 *pur;* in 1912 *rhom;* in 1921 *dav* and *pur;* in 1922 *pur;* in 1923 *will;* in 1925 *pur;* in 1926 *ung;* 16 *will;* 23 *dud;* 33 *pur;* 42 *def;* 43 *epi;* 46 *rhom;* 58 *cyl;* 70 *rhom;* 135 *bott;* 150, 151 *pur;* 161 *vir;* 183 *pur;* 192 *ung;* 221 *pur;* 257, 331 *rub;* 335 *dav;* 354 *pur;* 397 *ung;* 404 *pur;* 409 *epi;* 445 *cyl;* 507, 508 *pur;* 529 *cyl;* 532 *rhom;* 535 *ung;* 567, 585 *pur;* 592 *cyl;* 615 *rhom;* 619 *bil;* 620 *pur;* 622 *cyl;* 631 *ung;* 632, 664 *pur;* 686 *lass;* 828 *grac;* 871, 958 *pur;* 1114, 1149 *rhom;* 1327 *mil;* 1405 *pur;* 1430 *mil;* 1546 *rub* and *am;* 1547 *am* and *pur;* 1579 *bott* and *rub;* 1602 *am;* 1635 *dav;* 1906 *ung;* 2213a *am;* 2928 *rhom;* 2929 *epi* and *sim;* 3297 *con;* 3322 *pur;* 3324 *am;* 3404 *ung;* 3437 *bil;* 3442 *will;* 4208 *ung;* 4549 *pur;* 4592 *grac;* 4595 *con;* 4596 *grac* and *pur;* 4610, 4643 *pur;* 4684 *rhom;* 4770 *dav;* 4883 *am;* 6459 *epi;* 6936 *aff;* 7884 *lass;* 8923 *epi;* 8958 *def;* 8962 *pur;* 9037 *dud;* 9076 *pur;* 9181 *rhom;* 9305 *def;* 9321 *am;* 10518 *pur;* 10562 *grac;* 10582, 10593 *pur;* 10637, 10663 *am;* 11078 *ung;* 11389, 11490 *am;* 11734 *aff;* 12174 *am;* 12473 *brew;* 12493 *mod;* 12498 *dud;* 12540 *pur;* 12577 *will;* 12658, 12735 *pur;* 12886 *grac;* 13142, 13408, 13559 *pul;* 13566 *rhom;* 13809 *pur;* 13819 *aff;* 13820 *cyl;* 13852 *def;* 13877 *pur;* 13881 *cyl;* 13892, 13913 *pur;* 14457 *rhom;* 14990, 15132 *spec;* 15133 *pur;* 15139 *cyl;* 15148 *pros;* 15183, 15198 *pur;* 15212 *am;* 15257 *pur;* 15262 *grac;* 15346 *rhom;* 15393 *pur;* 17222 *rhom*
Eastwood & Howell, in 1938 *sim;* in 1940 *lass;* 2192 *pur;* 2261 *def;* 2291 *pur;* 2321 *mod;* 2356 *spec;* 2365 *ung;* 2382 *def;* 2809 *pur;* 2816 *grac;* 2842 *am;* 3134 *pul;* 3154 *rhom;* 3435 *pul;* 3558, 3638 *am;* 3688 *pur;* 3777 *sim;* 3783 *am;* 4191 *pur;* 4195, 4239 *aff;* 4380 *grac;* 4522 *pur;* 4578 *am;* 4636, 4658 *pur;* 4656 *grac;* 4732 *pur;* 4802 *grac;* 5069 *am;* 5291 *ung;* 5333, 5337 *pur;* 5362 *mod;* 5446, 5544, 5593 *pur;* 5614 *grac;* 5648 *pur;* 5840 *ung;* 5850 *cyl;* 5879 *pur;* 5904 *cyl;* 5916 *spec;* 5943, 5973, 5983 *pros;* 6067 *rub;* 6085 *am;* 6189 *dav;* 6268 *am;* 7415 *pur;* 7416 *grac;* 7421 *am;* 7960, 7983 *lass;* 8604 *will;* 8610 *bil;* 8811, 9647 *cyl;* 9697 *am;* 9749 *rhom*
Edmonds, in 1890 *rhom*
Edwards, in 1871 *will;* in 1873 *am;* in 1875 *rub;* in 1877 *pur, grac,* and *ung;* in 1878 *con;* in 1917 *grac, pur, rhom,* and *con*
Eggleston, 7509 *lass;* 9087, 9167 *pur;* 9444 *bil;* 9535 *rhom;* 9701 *vir;* 12690 *pul;* 11355 *rhom;* 11385 *pul;* 11505 *rhom;* 13092 *pul*
Elliott, 607 *ten*
Ellison, in 1928 *pul*
Elmer, in 1897 *pul;* in 1903 *pul;* 88 *pul;* 1524 *rhom;* 1992 *aff* and *rub;* 2223 *aff;* 2470 *def;* 2565 *am;* 2567 *am* and *pur;* 2922 *con;* 2977 *ung;* 3012, 3185 *pur;* 3186 *ung;* 3191, 3193 *spec;* 3194 *rhom;* 3195 *cyl;* 3791, 3792 *pur;* 3848 *def;* 3877 *ung;* 4155 *epi;* 4168 *rhom;* 4293 *ung;* 4310 *rub;* 4319 *bil;* 4336 *con;* 4343 *brew;* 4356 *con;* 4376 *pur;* 4436 *grac;* 4464 *brew;* 4610 *dav;* 4645, 4782 *bott;* 4825 *pur;* 4939 *am;* 5053 *rub;* 5076 *ung;* 5082 *rub;* 8632 *pur*
Elrod, 94, 118 *pul*
Embree, 39 *grac;* 43 *pur*
Emery, in 1926 *xant*
Engleman, in 1872 *rhom*
Epling, in 1925 *cyl, def* and *pur;* in 1926 *ung, pur, def,* and *cyl;* in 1929 *rhom;* in 1931 *pur* and *def;* in 1933 *def;* 5485 *pur;* 6031 *rhom;* 6032 *pul;* 6367 *am;* 8402, 8541 *ung;* 8542 *bott*
Epling & Anderson, in 1930 *ung*
Epling, Darsie, Knox, & Robison, in 1932 *rhom* and *pur*
Epling & Dunn, in 1931 *pur, cyl,* and *rhom*

Epling & Houck, 9143 *rhom;* 9180 *pul;* 10029 *rhom*
Epling & Lewis, in 1940 *del*
Epling & Robison, in 1935 *pur*
Epling & Stewart, in 1936 *epi*
Evans, in 1901 *dud* and *bil;* in 1922 *pur*, *ung* and *rhom*
Evermann, in 1916 *pur*
Ewan, 2251 *def;* 2376 *sim;* 3490 *cyl;* 3491, 3512 *def;* 4165 *ung;* 4218 *pur;* 7360, 8204 *rhom;* 8858, 8932, 9202 *con;* 9744 *rub*

Fauntleroy, in 1914 *ung*, *dud*, and *pur*
Ferguson, in 1919 *ung*
Ferris, 1714 *cyl;* 3696 *bott;* 4149 *con;* 4150 *rhom;* 4151 *mod;* 6336, 6353 *grac;* 6373 *pur;* 6408 *con;* 6955 *pur;* 8344 *aff;* 8430 *pur;* 9385, 9385*A* *am;* 9752 *cyl;* 9758, 9759, *pur;* 9764 *pur* and *spec;* 9776 *cyl*
Ferris & Bacigalupi, 2481*A* *rhom;* 10356, 10365 *cyl;* 10376 *nit;* 10377 *pur;* 10379 *will;* 10406, 10408 *pur;* 10410 *dud*
Ferris & Duthie, 82 *lass;* 199, 566 *rhom;* 592, 834, 1357 *pul*
Ferris & Lorraine, 11711 *grac;* 12346 *dud*
Ferris & Rossbach, 9432 *aff*
Ferris & Wiggins, 8120 *dav;* 9804 *cyl*
Feudge, 195 *pur;* 196 *rhom;* 1562 *pur;* 1904 *dud;* 1905 *pur;* 1906 *dud;* 1174 *cyl;* 1712 *ung;* 1798 *rhom*
Fiker, 700 *pul;* 3506 *rhom;* 3572 *pur*
Fischer & Johnson, *F*246 *rhom*
Fisher, 101 *dud;* 121 *ung*
Fitzpatrick, in 1902 *pul*
Fleet, 1234 *rhom*
Fleisher, in 1927 *cyl*
Fletcher, 811*a* *am*
Flett, in 1899 *pul;* 84, 311 *am*
Forwood, in 1887 *pul;* 124 *pul*
Fosberg, 947 *epi;* 986 *rhom;* 4408, 4549, 4636 *epi;* 4696 *pur;* 5188 *def;* 8117 *epi;* 8155, 8371, 8373 *pur;* 8590 *def*
Foster, in 1912 *pul*
Fotrell, in 1906 *con*
Fremont, in 1846 *arc;* 408 *grac;* 430 *con;* 435 *grac;* 482, 1046 *ung*
French, 814 *ung;* 815 *cyl*
French & Clar, 20 *ung*
Fritchey, in 1895 *ung;* 3 *pur;* 10 *ung;* 12 *am;* 13 *epi;* 56 *pur;* 81 *dud;* 82 *rhom*
Frost, 12 *rhom*

Gale, 222 *grac;* 294 *am*
Gander, 1180 *del;* 1399 *epi;* 1480, 2008 *del;* 2513 *rhom;* 3610 *epi;* 3627 *del;* 3740, 3741 *epi;* 4014 *del;* 4015 *sim;* 5374 *epi;* 5793 *sim;* 7415 8158, 8388 *epi;* 9346 *sim;* 9390, 9399 *epi;* 9468 *pur;* 11331 *epi;* 11356 *sim;* 11406 *epi*
Garaventa, 1282, 2439, 2577, 2578 *ten*
Garrett, in 1905 *rhom*
Gates, in 1918 *am* and *con*
Garvey, in 1921 *pur*
Gibbons, 119 *con*
Gifford, 164 *def;* 191 *ung;* 275 *vir;* 679 *ung*
Gigon, in 1886 *ten*
Gilkey, in 1944 *am*
Gillespie, 5550 *epi;* 9395 *arc*
Gilman, 23 *sim;* 555 *lass;* 631 rhom
Gilmore, in 1874 *brew*
Goddard, 170 *con;* 500 *cyl;* 606 *pur;* 610 *am*
Goodman, in 1921 *pur*
Goodspeed, 4595 *ten*
Gorman, 565 *rhom;* 3824, 4614 *am;* 5767 *pul*
Gotfredson, in 1927 *pul*
Gould, 417 *con;* 464, 741 *rhom;* 1261 *con*
Graff, in 1925 *con*
Graham, 400 *aff;* 572 *ung*
Grandjot, in 1934 *ten;* 3046 *ten*
Grant, in 1900 *epi;* in 1901 *will;* in 1904 *pur;* in 1915 *dud*, *pur*, *bil* and *ung;* 88 *sim;* 191 *rhom;* 523 *will;* 524 *def;* 648 *rhom;* 842 *dud;* 1160 *dud;* 2167 *rhom;* 2501 *ung;* 2508, 3854 *pur;* 6617 *sim;* 6626 *pur;* 6666 *def;* 6808 *pur;* 6888 *sim*
Grant, Ballon, & Ewan, 7889 *spec*
Graves, in 1900 *pur*
Gray, in 1885 *arc*
Gray & Gray, in 1925 *sim*
Greene, in 1886 *pur;* in 1889 *pur*, *will*, and *bil;* 834 *grac;* 835 *lass;* 836 *pur;* 874 *rhom;* 2982 *con*
Gregg, in 1948 *pur*
Gregory, in 1892 *epi*
Griffiths, 4459 *pur;* 4472 *dud;* 4501 *pur;* 4546 *rhom;* 6597 *ung*
Griffiths & Cotton, 376 *pul*
Grinnell, in 1905 *ung;* in 1906 *pur;* in 1910 *rhom;* in 1917 *pur;* 3, 5 *cyl;* 6, 121 *ung;* 190, 193 *spec;* 201, 229, 289 *xant;* 302 *spec;* 324 *rhom;* 333 *ung;* 378, 381 *cyl;* 390 *xant;* 500, 501 *pur;* 557 *dud*
Griepentrog, in 1927 *am*
Gross, 108, 170 *pur;* 202 *bil;* 224, 256 *pur*
Guirado, 638 *pros;* 701 *bott*
Gunckel, 2156 *ten*
Gustafson, 34 *pul*

Haines, in 1938 *dud* and *will*
Haines & Warne, 206 *dud*
Hall, E., in 1874 *pur;* 187, 188 *pur;* 191 *am;* 192 *grac;* 193, 194 *pur*
Hall, H. M., in 1897 *dud;* in 1899 *pur* and *rhom;* in 1900 *will;* 273 *epi;* 593 *pur;* 651 *rhom;* 679 *pur;* 1105, 1415 *dud;* 1576 *bil;* 2262 *pur;* 2264 *rhom;* 2265 *dud;* 2270 *rhom;* 3138 *epi;* 3192 *aff;* 3194 *pur;* 3200 *ung;* 3871 *epi;* 6240, 6241 *pur;* 6279 *cyl;* 6291 *xant;* 6296 *ung;* 6306 *xant;* 6403 *rhom;* 6599 *xant;* 7838 *pur;* 7848 *ung;* 8359 *dud;* 8500 *con;* 8511 *dav;* 8987 *dud;* 9022, 9109 *will;* 9112 *dud;* 9271 *pur;* 9493 *grac;* 9939 *brew;* 9974 *spec;* 10079 *ung;* 10155 *bil;* 10291 *pur*
Hall & Babcock, 3313 *will;* 4088 *lass;* 4169 *rhom;* 4174 *lass;* 5001 *ung;* 5007 *cyl;* 5084 *xant;* 5089 *spec*

Hall & Chandler, 10 *cyl;* 15 *spec;* 97 *rhom;* 203 *will;* 465, 7405 *ung*
Hamlin, in 1904 *rhom*
Hammond, 144 *grac;* 145 *pur;* 146 *rhom*
Handschiegel, in 1925 *ung*
Hansen, in 1891 *will;* in 1892 *pur* and *ung;* 23 *bil;* 36 *will;* 528 *vir;* 531 *ung;* 532 *pur;* 675 *bil;* 1090 *arc;* 1092 *vir* and *rhom;* 1157, 1160 *pur;* 1165 *bil;* 1308 *rhom* and *ung;* 1323 *arc;* 1722, 1760 *pur*
Harford, 265 *pur*
Harris, 671, 3485 *am*
Harris & Tracy, 1261, 3251 *pur;* 3261 *grac;* 3265 *con;* 3277 *am* and *pur;* 3284 *rhom;* 3288 *con;* 3292 *rhom*
Harrison, 1892 *rhom;* 1897 *pur;* 7807 *rhom*
Hart, in 1927 *dud*
Harter, in 1928 *cyl*
Hartweg, 173 *pur;* 1725 *ung;* 1727 *pur;* 1728 *cyl;* 1729 *cyl* and *bott*
Harvey, in 1856 *ten;* 687 *epi*
Harvey & Tucker, 1709 *rub;* 1710 *pur*
Haskins, 22 *pur*
Hasse, in 1888 *pur;* in 1890 *pur, epi, def,* and *ung;* in 1891 *pur;* 4042, 4059 *pur;* 4083 *def*
Hasse & Davidson, 1708 *cyl*
Hastings, in 1900 *ten;* in 1927 *dud;* in 1931 *def* and *rhom;* 311 *ten*
Haver, 2542 *arc*
Hawbecker, in 1936 *will*
Hawthorne, in 1899 *ung*
Hawthorne & Blaisdell, in 1899 *ung* and *vir*
Hawver, in 1915 *pur* and *con*
Head, in 1920 *mil;* in 1921 *con, grac,* and *lass*
Heermann, in 1853 *ung*
Heller, in 1902 *pur, am,* and *rub;* in 1903 *pur* and *rhom;* in 1905 *grac, lass,* and *xant;* in 1908 *pur;* in 1918 *grac;* in 1937 *rhom* and *pur;* 3154 *pul;* 4051 *am;* 5576 *pur;* 5583 *con;* 5646 *pur;* 5682 *grac;* 5686 *ung;* 5726 *rub;* 5750 *ung;* 5752 *grac;* 5776 *con;* 5873 *rhom;* 6754 *pur;* 6757, 6807 *bott;* 6834 *pur;* 7412 *con;* 7441, 7445, 7446 *pur;* 7479 *rub;* 7482, 7658 *ung;* 7902 *pur;* 8382 *dav* and *pur;* 8384 *dav;* 8552 *aff;* 8778, 8813 *rhom;* 8990, 9011 *will;* 10176 *pul;* 10749 *pur;* 10767 *ung;* 11384, 11422 *pur;* 11451 *rhom;* 11457 *con;* 11458 *mod;* 11540, 11908 *pur;* 12354 *grac;* 12375 *am;* 12435 *rhom;* 12746 *bil;* 13128 *con;* 13420, 13552 *rhom;* 13759, 13879 *am;* 14562, 14598, 14599 *rhom;* 14611 *mil;* 14617 *rhom;* 14625 *grac;* 14638 *am;* 14642 *rhom;* 14885 *dud;* 14890 *pur;* 15041*a* *arc;* 15087, 15114 *con;* 15129 *rhom;* 15153 *mil;* 15234 *pur;* 15317 *am;* 15600 *con;* 15708 *mil;* 16121 *pur;* 16162 *grac;* 16188 *lass;* 16240 *am;* 16248 *dav;* 16475 *arc;* 16494 *pur;* 16503 *lass*
Heller & Brown, 5472 *pur;* 5537 *rhom;* 5584 *aff*
Heller & Kennedy, in 1907 *rhom;* 8720 *rhom;* 8721 *lass;* 8827 *pur*
Henderson, in 1882 *grac* and *am;* in 1894 *rhom;* in 1896 *grac* and *pur;* in 1904 *pul;* 348 *pul;* 349 *rhom;* 356 *am* and *pur;* 357 *pur;* 358 *am;* 359, 533 *grac;* 835 *pur;* 5404 *pul;* 5634 *rhom;* 7932 *pur;* 8892 *lass;* 9030 *pul;* 12762 *rhom;* 12995, 13652 *pur*
Hendrix, 156 *pur;* 185 *cyl;* 1005 *ung;* 1023 *cyl*
Henshaw, in 1893 *pur, del,* and *sim;* 27 *sim;* 189 *del* and *sim*
Hewatt, in 1932 *pur*
Hichborn, in 1920 *rub;* 149 *pur;* 179 *am;* 255 *grac*
Hillman, in 1897 *lass*
Hitchcock, A. E., 154 *ung;* 215 *rub*
Hitchcock, A. S., in 1915 *dav, am, pur,* and *rhom*
Hitchcock, C. L., in 1929 *epi;* 1, 2 *cyl;* 3 *pur;* 4 *spec;* 6 *cyl* and *def;* 7 *pur;* 8 *spec;* 9 *con;* 10, 11 *bott;* 12 *rub;* 13, 15 *bil;* 16 *rub;* 17 *rub* and *grac;* 18, 19, 21, *grac;* 22, 23, 24, 25, 26 *rub;* 29 *bil;* 30 *pur;* 31 *will;* 33, 34 *bil;* 35 *cyl;* 36 *spec;* 37 *pur;* 40 *spec;* 41 *pur;* 42 *spec;* 43, 44 *cyl;* 45, 46, 47 *dud;* 48 *epi;* 49, 50, 51 *def;* 53, 54 *pur;* 55, 56 *cyl;* 57 *def;* 58 *pur;* 59 *def;* 550 *pur;* 1797 *pul;* 6393 *grac;* 6410 *arc;* 6495 *grac;* 6529, 6596, 6610 *lass;* 6624 *pur;* 6639, 6729 *grac;* 13763 *pur;* 15416 *rhom;* 15450, 17514, 17622, 17749, 17556, 18346 *pul*
Hitchcock & Martin, 4758 *am;* 4887, 5005 *rhom;* 5007, 5008 *pur;* 5012 *am;* 5075 *pur;* 5420, 5430, 5432, 5449, 5455 *am;* 5456 *will*
Hitchcock & Muhlick, 9091 *pul;* 9754 *rhom;* 10074, 13863 *rhom*
Hoak, in 1912 *pur* and *am*
Hoffman, in 1927 *pur;* in 1929 *mod, epi* and *spec;* in 1930 *epi* and *pros;* in 1931 *pur* and *cyl;* 692 *pros*
Holden, in 1891 *brew* and *rhom*
Holman, in 1921 *am*
Holt, in 1951 *ung*
Hooker & Gray, in 1877 *bott* and *am*
Hoover, 578 *pur;* 623 *nit;* 625, 1004 *pur;* 1019 *cyl;* 1029 *pur;* 1035 *cyl;* 1136 *pur;* 1162 *rhom;* 1235 *pur* and *nit;* 1257 *ung;* 2022 *cyl;* 2034 *pur;* 2058 *cyl;* 2110 *ung;* 2183, 2202 *pur;* 2367 *will;* 2368 *bil;* 2452, 2471 *dud;* 3231 *grac* and *aff;* 3301 *ung;* 3356 *pur* and *aff;* 3358 *ung;* 3365 *mod;* 3366 *brew;* 3378 *cyl;* 3396 *arc,* 3435, 3447 *mod;* 3463 *cyl;* 3470, 3476 *mod;* 3495, 3505 *pur;* 3518 *nit;* 3538 *grac;* 3603 *con;* 4068 *pur;* 4397 *arc;* 4904 *epi;* 5032 *con;* 5083 *grac;* 5108 *rub;* 5275 *pur;* 7065 *pur;* 7128 *mod;* 7196 *cyl;* 7234 *def;* 7235 *pur;* 7387 *rub*
Hopping, in 1901 *ung;* 29 *cyl;* 95 *mod*
Hormay, 152 *pur*
Horn, 1863 *xant*
Horner, 204 *rhom;* 13205 *pul*
House, 4842 *am*
Howden, 192 *rhom*
Howe, in 1947 *ung* and *cyl;* in 1948 *def*
Howell, J., in 1876 *am;* in 1877 *pur;* in 1883 *grac;* in 1884 *grac;* in 1889 *pur;* 178 *pur;* 5416 *am*

Howell, J. T., 30 *pur;* 48 *rhom;* 114 *dud;* 147 *will;* 155, 1003 *def;* 1012 *ung;* 1065 *nit;* 1073 *pur;* 1140 *rhom;* 1929 *pros;* 2016 *ung;* 2081 *rhom;* 2550, 3756 *def;* 3777 *sim;* 3864 *cyl;* 3868 *def;* 3875 *pur;* 3880 *dud;* 4245 *dav;* 4268 *ung;* 4279 *con;* 4301 *pur;* 4303 *grac;* 4803 *pur;* 5157 *ung;* 5410 *am;* 6223 *epi;* 6481 *ung;* 6483 *aff;* 6551 *pur;* 6591 *epi;* 6640 *pur;* 6773 *grac;* 6775 *rhom;* 6818 *pur;* 11030 *aff;* 11942 *lass;* 12003 *grac;* 12048 *rhom;* 12069 *lass;* 12277 *grac;* 12936 *sim;* 12954 *brew;* 12964 *mod;* 12969, 12970 *aff;* 13067 *pur;* 13307 *rhom;* 13796, 13818, 13835, 13847 *pur;* 13857 *nit;* 13882 *dud;* 13883, 18004 *mod;* 18104 *aff;* 19242 *rhom;* 20987 *pur;* 21022 *grac;* 21032 *pur;* 21073 *grac;* 21202 *pur;* 21230 *am* and *grac;* 21315 *imb;* 21811, 21912 *grac;* 22012 *am;* 23332 *pur;* 28309 *aff;* 29049 *arc*
Howell, T. J., in 1880 *pur* and *am;* in 1884 *pur;* in 1886 *pur;* in 1887 *pur;* 138, 139, 174, 703, 704, 1143, 1144 *pur*
Howell & Henderson, in 1882 *pur*
Howell & Howell, 326 *grac*
Hyde, in 1935 *pur*

Illin, 54, 148 *ten*
Illingworth, in 1898 *dud* and *pur*

Jackson, in 1932 *bil*
Jaeger, in 1921 *pur;* in 1925 *dud;* 938 *dud*
Jaffuel, 3702 *ten*
Jaffuel & Pirion, 3142, 3660 *ten*
Jardine, 66 *pul*
Jeffrey, in 1946 *pul*
Jenkins & Street, in 1917 *pur*
Jensen, 12 *spec*
Jepson, in 1890 *pur* and *vir;* in 1891 *aff, pur,* and *con;* in 1892 *rhom* and *con;* in 1893 *pur, con,* and *am;* in 1896 *rub, will,* and *bil;* in 1897 *con, ung,* and *rub;* 1625 *pur;* 2242 *am;* 2441 *pur;* 2656A *cyl;* 2690 *mod;* 2745 *pur;* 7572 *con;* 8387 *dud;* 8973 *con;* 13334, 13335, 13340 *pur;* 14365 *will;* 14372 *pur;* 14422 *vir;* 16324 *grac;* 19171 *pur*
Jessel, in 1927 *dud, rhom, ung, will,* and *spec*
Johannsen, 65 *ung;* 106 *pur;* 140 *mil;* 664 *brew;* 819 *pur;* 886 *bil;* 1096 *pur;* 1141 *ung;* 1150 *cyl;* 1151 *pur;* 1223 *will;* 1238 *rhom*
Johannsen & Gifford, 346 *arc*
Johnson, in 1928 *def;* 426 *pul;* 1326 *rhom;* 1327 *epi;* 2284 *def;* 4058 *pur;* 4093 *ung;* 4105, 4293, 4452 *pur;* 4469 *ung;* 4996 *pur*
Johnston, in 1925 *dud;* in 1931 *pul;* 1404 *rhom;* 1149 *def;* 1963 *pur*
Jones, M. E., in 1881 *pros* and *con;* in 1882 *am* and *pur;* in 1883 *grac* and *pur;* in 1897 *lass, rhom,* and *pul;* in 1899 *rhom* and *pul;* in 1901 *rub;* in 1902 *pul;* in 1903 *cyl;* in 1904 *pul;* in 1908 *pul;* in 1909 *pul;* in 1911 *pul;* in 1924 *dud;* in 1926 *ung, pur, def, dud,* and *rhom;* in 1927 *cyl* and *epi;* in 1930 *pul;* in 1931 *grac;* in 1932 *pur;* 106, 107, 1838 *rhom;* 2255 *ung* and *vir;* 2295 *pur;* 2348 *rub;* 2719 *rhom;* 3165 *epi;* 3340 *bil;* 3341 *will* and *pur;* 4992 *pul;* 6321 *pul;* 20038 *ung;* 28987, 28988, 28989, 28990, 28991 *am*
Jones, V., in 1920 *lass*
Jones, W. W., 199 *pur*
Josephson, 32 *will*
Junkans, in 1915 *lass* and *con*
Jussel, in 1931 *con;* in 1937 *am* and *pur;* 187 *rhom;* 254, 254A *pur;* 254B *am*
Just, 1312 *rhom*

Keck, 413 *dud;* 419 *bil;* 420 *ung;* 445 *rhom;* 1198 *will;* 2166 *cyl;* 2205 *epi;* 2353 *ung;* 2401 *con;* 2445 *dud;* 2765, 2826 *ung;* 4573 *dav;* 4580 *am*
Keck & Clausen, 3578 *pul*
Keck & Heisey, 5071 *bott;* 5101, 5106 *pur;* 5113 *cyl;* 5136 *def;* 5138 *aff;* 5150 *pros*
Keck & Heusi, 300 *will*
Keck & McCully, 104 *del;* 105 *pur;* 111 *sim*
Keck & Stockwell, 3264 *exi;* 3356 *brew*
Kelley, in 1916 *am;* in 1917 *pur, mod,* and *epi;* in 1922 *cyl, ung,* and *rhom;* in 1925 *grac*
Kellogg, in 1866 *rub, pur,* and *con;* in 1870 *pur;* in 1903 *pur*
Kellogg & Harford, 264 *am* and *def;* 266, 269, 270, 271 *pur;* 272 *am;* 273 *pur,* 274 *am;* 281 *pul;* 282 *ung;* 285 *con*
Kelsey, in 1891 *rhom* and *pul*
Kendall, in 1923 *epi*
Kennedy, in 1876 *cyl;* 9 *lass;* 1641 *rhom;* 3022 *will*
Kerr, in 1929 *spec*
Kildale, 723 *rhom;* 804 *pur;* 873 *con;* 1035 *am;* 2042 *rhom;* 2128, 2141 *pur;* 2184, 2367 *am;* 3179, 3179*a* *con;* 3584 *pur;* 3696 *rhom;* 3749, 3836 *am;* 3953*a* *con;* 4958 *mod;* 5233, 5262, 5291 *am;* 5292 *rhom;* 5293 *pur;* 5356 *rhom;* 5699 *am;* 5796 *rhom;* 6171, 6240 *am;* 7075, 7914 *pur;* 7924 *grac;* 7926, 8195 *rhom;* 8228, 8233 *pur;* 8348 *pur* and *grac;* 8459 *grac;* 8924 *am;* 9153 *con;* 9199 *rhom;* 9202, 9695 *con;* 9699 *pur;* 9707 *rhom;* 9717 *con;* 10719 *rhom;* 10742 *con;* 10810 *rhom;* 10815 *pur*
Kildale & Gillespie, 8027 *rhom;* 8348 *grac*
Kimber, 2, 52 *am*
King, in 1892 *con;* in 1893 *rub, pur,* and *epi;* in 1894 *bil;* in 1895 *epi, ung,* and *spec;* in 1897 *grac* and *con;* in 1905 *pur;* in 1907 *bil* and *rhom*
Kingman, in 1910 *dud* and *pur*
Kirkwood, 99 *pul;* 169 *am*
Kleeburger, in 1880 *pur, con,* and *rhom*
Klyver, in 1926 *rhom* and *will*
Krautten, 119 *pur*
Kreager, 15 *pul;* 601 *rhom*
Kruckeberg, 2141 *pul*
Kuntze, in 1892 *ten;* 23118 *ung;* 28108 *am* and *pur*

La Greata, 310 *pvr;* 536 *dud*
Lake & Hull, in 1892 *pul*

Lamm, 17045 *pul*
Lang, in 1924 *cyl*
Large, 85 *rhom*
Larson, in 1931 *rhom;* 6108 *rhom*
Lathrop, in 1903 *ung*, *mod*, and *pur*
Lawrence, 161 *pul;* 161*b* *rhom;* 189 *am;* 283, 377 *pul;* 1651, 1703, 2080 *pur*
Leach, 2426 *am*
Lee, 322 *cyl;* 324 *pur;* 368 *ung;* 661 *pur;* 671 *ung;* 878 *pur;* 879 *aff;* 917 *pur;* 942 *cyl;* 948, 993 *spec*
Leiberg, in 1890 *pul;* 273 *grac;* 482 *rhom;* 1090 *pul;* 1289 *rhom;* 2334 *pul;* 3319 *dud;* 3334 *pur;* 4087 *am;* 4103 *grac;* 4161 *pur;* 4185 *am;* 5040 *grac;*
Leithold, in 1893 *am* and *grac;* in 1894 *ung*
Lemmon, in 1874 *will*, *grac*, and *lass;* in 1875 *lass;* in 1879 *pur;* in 1884 *grac;* in 1887–1888 *spec;* in 1889 *grac;* 246 *will;* 247 *dud;* 994 *pur;* 4539 *def;* 4546 *cyl;* 4567, 4587 *spec;* 4615 *def*
Leonard, in 1884 *rhom*
Lewis, B., in 1939 *pur*
Lingenfelter, 496 *pul*
Linsdale, in 1929 *aff;* 12 *pur;* 16 *cyl;* 18 *mod;* 48, 49 *cyl;* 386 *rhom*
Lloyd, in 1893 *am;* in 1894 *pul*, *grac*, *am*, *pur*, and *rhom;* in 1898 *pul;* in 1933 *def*
Lobb, 1854 *def*
Looser, 361, 1094, 2284, 2285, 2287, 2289, 2294, 2295 *ten*
Loveless, 161 *rhom*
Lundgren, in 1933 *ung* and *rhom*
Lunell, in 1903 *pur;* in 1907 *grac*
Lyall, in 1858–1859 *am*
Lyon, G., 68 *grac;* 913 *aff;* 915 *pur*
Lyon, W. S., in 1884 *pur;* in 1885 *epi*

McAllister, 2 *grac*
Macbride, 100 *pul;* 379 *rhom*
Macbride & Payson, 724 *pur;* 756 *dud;* 757 *ung*
McClatchie, in 1892 *def*, *pur*, and *sim;* in 1893 *epi;* in 1896 *ung* and *rhom*
McClintock, in 1938 *rhom* and *pur*
McCoullough, 324 *pul*
McCracken, in 1938 *pur* and *rhom*
McDonald, in 1915 *cyl*, *ung*, and *nit;* in 1925 *spec* and *pur;* in 1931 *will;* in 1932 *will*, *pur*, *cyl*, and *mod*
MacDougal, 146 *pul*
MacFadden, in 1933 *ung;* 2600 *epi;* 13496 *def;* 13610 *xant;* 13924 *pul;* 14615 *def;* 14683 *cyl;* 15491 *rhom;* 25005 *pul*
McGregor, in 1907 *aff;* in 1918 *rhom;* in 1921 *am;* 28 *ung;* 29 *bott;* 914, 922 *rhom*
McKeever, 3234 *pur*
Mackie, in 1904 *ung*
McLean, in 1873 *rub*
McMurphy, in 1914 *bil* and *ung;* 204, 205 *am*
Macoun, in 1890 *pul;* in 1897 *am;* 42, 253 *am;* 64602, 64603 *pul;* 85893 *am*
Macrae, in 1825 *ten*
Maguire, 15849, 17296 *pul*
Maguire & Holmgren, 26424 *pul;* 26584 *rhom*
Mallory, in 1920 *aff*
Manning, in 1902 *con;* 75 *con;* 154 *lass;* 282 *rhom*
Marshall, in 1886 *rhom*
Mason, in 1921 *pur*, *epi*, *ung*, and *rub;* 391 *cyl;* 906 *pur;* 2123 *bil;* 2149 *will;* 2150 *rhom;* 3135, 3246 *pur;* 3247 *rub;* 3250 *ung;* 3270 *bil;* 4557 *brew;* 4881 *am;* 5355 *spec;* 5356 *cyl;* 5615 *dav;* 5621 *con;* 6947 *aff;* 6997 *arc;* 12282 *brew*
Mason & Lee, 9229 *bott*
Mathias, 768 *am* and *grac;* 850 *dud*
Mearns, 3527, 3595 *rhom*
Meehan, in 1883 *pur* and *ung;* 2295 *will*
Merriam, in 1922 *am*
Metz, 55 *dud*
Mexia, in 1926 *ung;* 2394 *con*
Meyer, 382 *ung;* 880, 908 *pul;* 1506 *rhom*
Michael, in 1923 *bil*
Michener & Bioletti, in 1891 *con* and *dav;* in 1892 *grac*, *pur*, and *dav;* in 1893 *grac* and *con;* 177, 178 *pur;* 179, 679*a* *rub*
Miles, in 1868 *spec* and *pur;* in 1891 *epi*
Miller, in 1921 *rhom;* in 1939 *bil* and *vir*
Miossi, 87, 262 *def;* 258 *ung*
Moldenke, 7074 *rhom;* 7111 *dud;* 7112 *will*
Monks, 41 *ung*
Monnet, 936 *lass*
Montero, 55 *ten*
Moore, 17, 443 *pul*
Morley, in 1941 *pur* and *mod*
Morrison, in 1929 *rhom;* in 1932 *arc*, *pur*, *rhom*, and *con;* 16838 *ten*
Morten, 2855 *rhom*
Mosier, in 1892 *am*
Moxley, 236 *dud*
Mulliken, 108 *bil;* 115 *will*
Munz, 2175 *epi;* 2242, 3877 *pur;* 5052 *epi;* 5771 *rhom;* 6879 *xant;* 6925 *pur;* 6926 *cyl;* 7091 *rhom;* 7172 *pur;* 7368 *will;* 8005 *epi;* 8020 *del* and *sim;* 8217 *pur;* 8232 *rhom;* 9439 *epi;* 9496*a* *del;* 9712 *rhom;* 9867 *pur;* 9871 *con;* 9876 *rhom;* 9880 *grac;* 9883 *pur;* 9884 *am;* 9886, 9887, 9894, 9900 *pur;* 9919 *pul;* 10299, 10358 *pur;* 10422 *epi;* 10814 *dud;* 10815 *pur;* 10816 *sim;* 10888, 10917, 11055, 11313 *pur;* 11317 *dud;* 11318 *pur;* 11429 *pur* and *cyl;* 11435 *cyl;* 11438 *ung;* 11442 *pur;* 11446 *cyl;* 12625 *del;* 13156 *ung;* 13205 *pur;* 13246 *con;* 14311, 14339 *am;* 16285 *cyl*
Munz & Crow, 11861 *epi*
Munz & Harwood, 2933 *epi;* 3927 *def;* 3984, 4009 *epi*
Munz & Hitchcock, 10904 *rhom;* 11363 *sim*
Munz & Johnston, 5333 *pur;* 5340 *epi*
Munz, Street, & Williams, 2618 *epi;* 2647 *def;* 2669 *pur*
Murbarger, 172 *epi*
Murdock, in 1930 *epi;* 2529 *dud*
Murley, 1678 *pul*
Murphy, 2, 25 *pul*

Nelson, 330, 801, 802 *am;* 1405 *rhom;* 1436 *pur;* 1652 *am;* 1697 *pur;* 1865 *rhom;* 2221, 2719 *grac;* 2721 *rhom;* 3829, 3919 *pur;* 4309 *rhom;* 4891 *am*
Nelson & Macbride, 1262 *rhom*
Nevin, 32*a* *dud*
Newell, in 1900 *am;* in 1904 *pur;* in 1905 *pur;* in 1913 *def;* in 1914 *rub* and *ung*
Newlon, 8 *con*
Newsom, in 1929 *grac*, *dud*, and *rhom*
Nordstrom, 42 *pur;* 167 *mil;* 764 *arc;* 794 *pur;* 820 *bil;* 1203 *pur;* 1204 *aff;* 1226 *spec;* 1227 *ung*
Norton, in 1880 *rub*
Nuttall, in 1920 *epi;* 239 *pur*
Nutting, in 1930 *lass*

Oliva, 6 *ten*
Oliver, 1884 *xant*
Olsen, in 1926 *pur*
Orcutt, in 1884 *epi* and *rhom;* in 1885 *del* and *rhom;* in 1886 *pur* and *epi;* in 1889 *pur;* 2749 *epi*
Orcutt & Brown, in 1884 *pur*
Osborne, in 1938 *del*
Otis, 471 *pul;* 2024 *am*
Ownbey, 1833 *pul*

Palmer, in 1876 *spec;* in 1902 *epi* and *dud;* 66 *spec;* 98 *rhom;* 104, 141, 142 *pur;* 143 *spec;* 144 *pur;* 145 *def;* 147 *ung;* 149 *pros;* 299, 2066 *pur;* 2321 *bil;* 2386 *ung;* 2388 *bil;* 2407 *con;* 2418*b* *pur;* 37789*a* *pul;* 37958 *am*
Parish, in 1886 *epi;* in 1888 *pur;* in 1891 *sim;* in 1897 *pur;* in 1898 *pur* and *dud;* 273, 275 *pur;* 454 *rhom;* 951, 952 *dud;* 953 *rhom;* 957 *dud;* 1095 *epi;* 1501 *pur;* 1898 *xant;* 1899 *cyl;* 2047 *ung;* 3079 *dud;* 3222 *pur;* 3494 *rhom;* 3485 *pur;* 3672 *dud;* 4743, 4987 *pur;* 5025, 5026 *rhom;* 5054 *dud;* 5235 *pur;* 5624 *epi;* 5815 *dud;* 5829 *rhom;* 5830 *pur;* 7109, 10209 *dud;* 10617 *pur;* 10956 *rhom;* 11215 *epi;* 11286 *pur;* 11316 *dud;* 11780 *pur;* 11937 *rhom;* 11957 *dud;* 20041 *cyl*
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Parodi, 11413 *ten*
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Patterson & Wiltz, in 1907 *pros* and *bott*
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Peckham, in 1866 *pur*, *cyl*, and *def*
Peebles, 3903, 9182 *epi*
Peebles & Smith, 1535 *rhom*
Peirson, 771 *cyl;* 3792 *am;* 7300, 7302 *xant;* 7311 *cyl;* 8388 *pur;* 8391 *cyl;* 10281 *rhom;* 10678 *cyl;* 10680 *xant*
Pendleton, 173 *pur;* 346 *con;* 395 *rub;* 740, 755 *con;* 782 *aff;* 784 *pur;* 809 *con;* 832 *pur*
Pequegnat, in 1938 *pur*, *def*, and *rhom;* in 1940 *pur* and *epi;* 25 *pur*
Pérez, 143 *ten*
Peterson, 253 *rhom;* 785 *pur;* 824, 835 *cyl*
Pettibone, in 1894 *con*
Pettibone & Hubley, in 1895 *pur*, *epi*, *mod*, and *def;* in 1896 *pur*
Phelps, in 1934 *am;* in 1937 *pur*
Philippi, in 1882 *ten*
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Piper, in 1895 *am;* in 1896 *rhom;* in 1921 *pur* and *grac;* 1628 *rhom;* 1630 *pul;* 4981 *am;* 5054 *grac;* 6273, 6287 *pur;* 6360 *lass;* 6365 *grac*
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Pringle, in 1882 *def* and *ung;* 269 *epi*
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Purer, 5848 *ung;* 6495 *pur;* 6584 *def;* 6587 *epi;* 6677 *pur;* 6686 *rhom;* 6699 *ung;* 6701 *def;* 6933*A* *del;* 7139 *epi*
Purpus, in 1889 *pur;* in 1898 *pur;* 1319 *ung;* 5035 *spec;* 5036 *dud;* 5298 *rhom;* 5538 *xant;* 5574 *spec;* 5586 *ung;* 5631 *rhom*

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Van Dyke, in 1928 *pur*, *cyl*, and *rhom;* in 1931 *grac*, *pur*, *cyl*, *bil*, and *ung*
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